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SUMMER ACTIVITIES OF CALIFORNIA RACCOONS

BY LLOYD TEVIS, JR.

A favored foraging beat of California raccoons (*Procyon lotor psora*) in the Santa Lucia Mountains of coastal California is the deep canyon, accessible only by boat or trail, where the Carmel River enters San Clemente Lake. There during the middle of August 1945, and the end of July 1946, by using a three-cell flashlight and 7 x 50 night binoculars I was able to watch a little of their undisturbed nocturnal behavior.

The Environment.—Oaks and chaparral clothed the canyon sides to the lake; alders banked the river, whose midsummer waters swirled around shining, silt-covered boulders. In this environment are found crayfish and manzanita, a chaparral shrub, both of which contribute to the raccoons' diet. The crayfish (*Astacus*), a commonly seen invertebrate of the lake bottom and river pools, was active by day as well as by night when the raccoons were abroad. The two kinds of manzanita, the bigberry (*Arctostaphylos glauca*), which was rare, and the Eastwood (*A. glandulosa*), which was common, ripened their berries in July and August.

Detection of raccoons.—By day I knew of the raccoons from their tracks, their droppings, and the remains of their nocturnal feasts; by night from their vocalizations and eyeshine. During the day the rough waters of the receding lake carved the beaches vertically, while the calm waters of the night left a smooth slope. Tracks on the lowest slope told what had walked at the water's edge the night before. Raccoon tracks were usually headed downstream.

Droppings were scattered indiscriminately as well as heaped on rock-defecation sites. According to Giles (1940, p. 375), the eastern raccoon shows a preference for similar sites. Three-fourths of 363 scats collected by him were associated with rocky prominences. On the ridges and the canyon sides above San Clemente Lake, the droppings contained only Eastwood manzanita berry remains, including the seeds which were unchanged, morphologically at least. On the canyon floor the droppings consisted of undigested parts of Eastwood manzanita berries or of crayfish, but not of both. The manzanita attracted the raccoons to one kind of ground, the crayfish to another. Elsewhere or at other times of the year the foraging program might be different. There were crayfish in only 2 of the 314 stomachs recorded from various parts of California by Grinnell, Dixon, and Linsdale (1937, p. 157).

Although the seeds of the two species of manzanita at San Clemente were easily differentiated, the nutlets of bigberry being united as a solid stone while those of Eastwood were separable, I found no bigberry in the droppings. Perhaps the excessively glandular-viscid exudate characteristic of these berries, but not equally developed in the other species, was unpleasant to the raccoon.

A typical dropping when the raccoon had been eating crayfish was a cylindrical, truncate mass of exoskeletal fragments, smoothly coated by a damp, finely pulverized reddish material. The color derives from the crayfish, for Grinnell, Dixon, and Linsdale (1937, p. 281) state that the river otter's fresh droppings are reddish when it, too, has gorged itself on crayfish to the exclusion of all else. With exposure to the sun the droppings of both animals turn white.

The uneaten remains of crayfish were common "coon sign" on boulders above the water. The bits left were usually the head, a part of the thorax, the pincers, a few of the smaller legs, and, sometimes, the swimmerets. In some cases when half the thorax was eaten, the pincers were left attached to the remaining portion. But when all the thorax was eaten they were severed and left lying as they fell, side by side. Only the tail was invariably consumed.

The raccoons were wasteful. The human connoisseur of *écrevise* praises the gastronomical quality of the crustacean brain. But he is able to put his lips to the smashed head and suck out the brain, while the raccoon, being less dexterous, would have to crunch the spines. The pincers are reputed to be the sweetest part of an *écrevise*. For the raccoon, however, there is too much sharp exoskeleton in proportion to the amount of meat. On July 27, 1945, along a 50-foot length of river I counted pincers and heads from 22 crayfish that were eaten the night before. Many others were under the water.

For comparison of the summer food habits of raccoons living at the opposite side of the continent, a report by Hamilton (1940, p. 83) is of interest. "Nineteen scats of the raccoon taken along the banks of the Schoharie River near Middleburg, New York, during August, 1938, contained chiefly the remains of crayfishes, with some insects, and a small quantity of corn." Yeager and Rennels (1943, pp. 51 and 57) in their thorough study of autumn foods of the eastern raccoon, ranked crayfish first in importance in animal foods, and in summarizing the work of previous investigators reported that corn, fruit, crayfish, and insects furnish the bulk of the food. In the forested region of eastern Texas, Baker, Newman, and Wilke (1945, p. 48) found that "acorns and crayfish constitute more than half of the yearly diet and both are consumed in considerable amount at all seasons."

The vocalizations of raccoons were part of the canyon's night sounds. When there were raccoons near they were generally heard. Their sounds were varied and often startling. There was the low grumbling purr by which a mother maintained contact with her cubs; the low soft snore and throaty, somewhat muffled growl of recognition when two members of a pair passed; the fierce, aspirated snort-growl, a bluffing challenge to combat; and the bedlam of loud, fierce, explosive snarls, snores, and growls of intolerance at the meeting of unsociable individuals.

Often early in the night when the flashlight was played along the lake shores, it revealed nothing animate. Later, around 9:30 or 10:00 p.m., it was sure to pick up a pair of glowing eyes moving rapidly downhill to the water through the masses of shrubbery above the bank. The eyeshine was brilliant. The color was orange, except that at a certain angle while the head was turning it shifted from orange to green and almost instantly back to orange. Walls (1942, pp. 230-231, 233-234) states that the physical basis of eyeshine in "all but two species of the great order Carnivora" is behind the retina in the choroid as a tapetum cellulosum, a layer of "thin, broad, tile-like cells" packed with highly refractive inclusions. Light after passing through the retina is flashed back, stimulating the retina a second time and thereby accentuating the contrast between dark and light. This condition is useful to nocturnal animals. Walls states further that the color of the reflected light may change from moment to moment with fluctuations in the blood supply of the choriocapillaris, but does not mention the color changing at a particular angle.

Observation of raccoons.—To find a raccoon at night my usual procedure was to play the flashlight along the shores or over the boulders of the river until it picked up the eyeshine. I did this either on foot or in a rowboat. After finding one I tried to keep it in sight as long as possible without disturbing it. I soon learned that although flooding the animal in light or flashing the light off and on was of no consequence, my footsteps or rowing had to be silent. At the crackle of a twig or the bumping of the oars against the boat, the raccoon glared into the blackness, after which its aroused suspicions more often than not were expressed by an abrupt departure. One animal was even frightened away by a natural night sound, the loud plop of a fish nearby.

In contrast to its sensitivity to sounds, raccoons were indifferent to the spotlight. An old one hunting crayfish alone on a sandbar covered by shallow water allowed my boat to drift quietly to as close as 10 feet, and even though I kept the animal in the concentrated beam of a flashlight, it went on fishing as though I were not there. Another time a mother with two cubs marched downsteam straight into the beam to a pool 12 feet from me, and there, still in the light, the three of them hunted crayfish.

Examples such as these led to the conclusion that the raccoon was not disturbed by the light, nor was its progress impeded, for it walked over and around slippery river boulders with confidence and sureness. The only one that reacted to the light was resting on a boulder. It stared longer into the light than in any other direction, as though a little puzzled, but within ten seconds its attention shifted elsewhere.

A partial explanation of the raccoon's disregard of the light, in which respect it differs from its associates of the woods—the gray fox and the black-tailed deer—may be its dependency upon senses other than sight. The raccoon, while locating crayfish by touch and aware of its environment through smell and hearing, may be only dimly receptive to visual impressions. Then, too, sounds such as the crackle of a twig are associated with the presence of an intruder, whereas the glare of the light awakens no association. A similar indifference to

light is suggested by Whitney's observations (1931, p. 36). He turned a powerful searchlight "for a long time" on a family of eastern raccoons in a tree. The young ones "sat there lapping each other around the ears and apparently enjoying a family party."

Because of indifference to light and reaction to sound, the best way to approach them was in a rowboat. By aiming the boat, giving it a gentle propulsion with the oars, and then letting it drift, I could avoid detection, and later, when the animal moved along the shores of the lake, the incoming current supplied the little momentum needed to keep abreast of it.

When a raccoon was wandering among the river boulders, it was lit up not only by the spotlight but also on all sides by the reflection from the shining, white silt deposit. In the brilliance between the sparkling of the foreground water and the shadowy tangle of logs, branches, and roots behind, the details of its actions were clear and easily followed.

Numbers and nightly program.—The greatest number of raccoons I spotlighted at one time in 1945 was nine, among which two mothers, each followed by two half-grown young. The greatest number in 1946 was four. Two of these were members of a pair. The third was an intruder, that was driven away. The fourth one approached no closer than about two hundred feet from the pair.

These figures indicated little regarding the population, for no one animal stayed long in any section of the lake or river. I got the impression that many raccoons were moving downstream but keeping apart so that only a few were seen at any one time. One would fish for awhile, then move on, and later be replaced. Their tendency to wander in conjunction with intraspecific intolerance, allowed the sampling of a large area without overcrowding any section. In favorable habitats the density of raccoons can be considerable. Yeager and Rennels (1943, p. 50) on the basis of the fur catch in the river bottom land of Pere Marquette Wildlife Experimental Area, Illinois, believed that in the autumn of 1939 there were 53 per square mile in that "superb habitat."

During low water at San Clemente Lake in August 1945, raccoons were heard every night, and there were many droppings and tracks along the shores. During high water in July 1946, the comparative rarity of sounds, tracks, and droppings indicated fewer animals. Because crayfish stay on the lake bottom and in deep pools, fishing during high water was not profitable, for much wading yielded little food. Because the raccoon is omnivorous, it is not bothered by scarcities of any one kind of food; by adapting its feeding habits and changing its foraging beats, it is able to make use of the most easily obtained food. Hamilton (1940, p. 84) and Yeager and Elder (1945, p. 54) commented on this fact for the eastern race.

Toward the end of July, when the lake receded as the streams dried up, great quantities of crayfish were trapped in shallow pools formed at the upper end. From then on the raccoons came to the water in numbers. A somewhat analogous situation in which availability determined the food was reported by Giles (1940, p. 379). Although the animals studied by him in eastern Iowa were not ordinarily eating fish, they did so when severe storms left fish stranded in puddles

and ditches. Another example is from eastern Texas where Baker, Newman, and Wilke (1945, p. 46) observed that "receding flood waters and small pools were literally alive with crayfish, and signs of raccoon were always abundant about such areas."

After the crayfish season started, I concluded from the evidence that when raccoons left their dens on the canyon side at the end of day, they fed first on manzanita berries, which were more abundant on the ridges, then moved to the river for crayfish, after which they returned to their dens. On the ridges, all their droppings were composed of manzanita berry remains, while on the canyon floor they were composed either of manzanita berries or crayfish. Another example of raccoons eating both a vegetable food and an animal food instead of gorging on one kind only has been reported by Grinnell, Dixon, and Linsdale (1937, p. 159): at a ranch where raccoons killed 19 chickens in three weeks and beat a path to the vineyard and fig orchard, "droppings showed that they had finished off their chicken dinner with figs and grapes!"

Fishing Habits.—August 10, 1945, was a moonless night with the ocean fog in and the quality of the air soft and mild. By eleven o'clock a solitary raccoon after crayfish had moved out onto a sandbar covered by shallow water. This individual was large and old. Even though it had to wade nearly up to its throat, it raised its tail and neck stiffly, and arched its back to avoid unnecessary wetting. It advanced in a straight line or turned abruptly and quickly until it captured a crayfish, which it hauled up in one paw, bit, crushed, and ate. The sounds of mastication, carrying far across the still lake, were audible even on the opposite shore. After finishing each crayfish, it searched for more with its snout skimming the water and its eyes seemingly staring into the depths. Now and then the head was turned horizontally from side to side, but the eyes did not lift from their continuous gazing into the water. The position of the head and eyes gave the impression that the animal looked for crayfish as well as felt for them. This impression may have been correct for, black though the night was, the raccoon may have been able to see the crayfish against the white sand.

In three respects this one's habits differed from those of others that I watched. It acted as though it disliked water; it appeared to use its eyes to find crayfish; and it ate its prey on the spot. One reason for these differences may be that the others, instead of fishing in the quiet water, were in the splashing, gurgling torrents that poured through the pools of the exposed river bed. There they waded in circuitous routes among the boulders, moving rapidly, feeling with their paws into the crevices between rocks, sometimes turning quickly to one side, and exploring the same pool again and again. What surprised me was the rapidity with which they shuffled along, their feet always under water, and their front paws extended forward as though rolling a ball endlessly and mechanically over the bottom of the pool. Sometimes one stopped for as long as 20 seconds, but the revolving motion of the shoulders indicated that it was still feeling with its paws.

More successful than the old raccoon on the sandbar, those along the river captured crayfish every three or four minutes. But to do so they had to enter

the water with such whole hearted abandon that they looked like aquatic mammals. They waded as deeply as they could. The water covered them almost to their snouts and wet their stiffly raised tails. They did not hesitate to swim. Instead of utilizing boulders to get around deep water, they paddled off in dog fashion, slowly but effectively, their tails straight out and half submerged. Apparently not minding the chill of the night air, only a few of them on leaving the water bothered to shake their bodies in a twisting, revolving motion that threw out a fine spray.

The longer I watched, the more certain I was that they detected crayfish by their paws alone and did not use their eyes. One wading with its head up so the snout would clear the water could not see what was scurrying about below. Even more convincing was one that poked both front feet so deeply under a boulder that it had to throw its head far back, as though contemplating the stars. Another rested its chin nonchalantly on a boulder while feeling underneath. Some stood on the bank and reached down into the water between the boulders while looking in another direction.

In order to understand this fishing I had to imagine the long, sensitive fingers exploring the bottom of the pool and poking into slimy crevices between rocks. And even though the actions seemed careless and indifferent, I could sense the alertness of those fingers for the touch of something alive, or, possibly, merely for vibrations in the water. When this nonchalance suddenly gave way, the tail jerked, and the body lunged. Apparently the fingers had touched and momentarily lost a crayfish, for in most instances the prey was hauled up without commotion. One raccoon smelled and then rejected an object that it had lifted out of the water. A second, while wading, noticed some claws and a head left by another raccoon on a boulder two feet away. It shuffled over, picked up one of the claws, ate part of the base, discarded it, and resumed the hunt—agreeing with the first animal as to the unpalatableness of the claws.

When they caught tiny crayfish or other small invertebrates, they ate them on the spot. A full-sized crayfish, on the other hand, was taken to the nearest boulder rising two or three feet above the water to be eaten. Sometimes after a raccoon had taken a crayfish to a boulder, it dropped the prey and, by putting both front paws on them immobilized the pincers. The raccoon then turned its head to one side, bared its teeth, and bit the flipping tail. With raised head the "coon" began a thorough, audible mastication, while the shifting eyes showed mild curiousity about happenings in the darkness beyond the alders. The food was never gulped; the chitinous exoskeleton was reduced to small pieces. Whitney (1931, p. 34 and 1933, p. 112) records that eastern raccoons never gulp their food, like dogs and foxes, but take plenty of time to masticate it well. Kernels of hard shelled corn were often split into six or eight pieces before being swallowed, and beechnut remains found in stomachs were very finely ground and pulverized.

At other times, instead of pressing the pincers on the boulder, the raccoon grasped them with one paw and raised the whole crayfish to its mouth. If during the chewing a piece fell, it was caught skillfully in midair by the paw that was holding the rest of the crayfish. The teeth were visible, for the coon chewed with drawn lips. Even from a distance I knew the kind of food by the

two fiery dots, the eyeshine of the crayfish, that glowed on the dark boulder or in the raccoon's paw.

After the raccoon had eaten as much as it wanted of the crayfish, usually not more than the tail and half to three-quarters of the thorax, it stepped back into the water. In no instance did I see one wash its prey. The "one who washes," the "wash-bear" of the Germans (Seton, 1909 p. 1024) did not justify its reputation. There is a dearth of factual information concerning the act of washing. Recently Hall (1946, p. 176) would commit himself no further than to say that at least captive animals wash their food. Ingles (1947, p. 48) wrote that "they are reputed to wash their food before eating it; but those observed by the author were never so meticulous." And Seth Briggs, editor of the "outdoor questions" department of *Field and Stream*, in the October, 1946, issue in reply to the query, "Does the raccoon always wash its food before eating it?" answered, "This seems to be a distinctive habit of the coon, provided water is available." In short, both the scientific and popular authorities express uncertainty. Doubtless many naturalists have a wealth of information on food washing by raccoons that would be published but for the notion that it is already known. The trapper, Parkinson, according to Grinnell, Dixon, and Linsdale (1937, p. 161) thought that even when near water they are not in the habit of washing their food unless they pick it out of the mud or sand. That explanation would apply to my animals, for they caught their crayfish on a rocky, clean streambed. If this is correct, apparently raccoons are able to recognize that clean food does not need washing. Whitney (1933, p. 108), on the other hand, who saw captives in dry enclosures rub their food with their paws as though washing it, concluded that the coon is a *feeler*, not a *washer*.

Not all of the fishing time was spent in looking for crayfish. One climbed up onto a boulder and relaxed. Squatting on its hind legs, it did not support itself on its front feet, but hung them limply over the side of the boulder, with the long, slender, separated fingers clearly discernible. They were treated as though they needed a rest more than did any other part of the body. Another stretched its head and neck around to the rear and bit its rump, possibly after fleas. Still another, stopping with the left foot raised and its weight shifting to the right paw, whipped its head to the left, and three times vigorously bit the fur behind the shoulder.

Intolerance and sociability.—On July 31, 1946, all the raccoons observed were single, grouchy, and intolerant of each other. On that night never more than two were seen at one time and, except in rare instances when passing was unavoidable, they were solitary. The abundance of food in the river pools had brought about a concentration of them, but their aversion for one another, perhaps a sense of competition for the food, prevented group formation.

I witnessed the meeting of two lone raccoons, one going downstream, the other upstream. They detected each other, when about 20 feet apart, and ceased fishing. Each approached the other cautiously and suspicously to within about 4 feet and prepared for trouble. One took a defensive position by pressing its body against a boulder and raising its head menacingly, with exposed teeth gleaming white in the spotlight. The second took what seemed

to be an aggressive position. Instead of crouching, it arched its back and stretched upward, seeming to grow taller. Its feet were widely spread for a solid stance on the wet, slippery boulder. With lips drawn back it glared down at its adversary. The ferociousness of its aspect expressed an eagerness to kill. They delivered continuous and explosive bursts of snarling, snoring, and growling, but nothing worse. After eight seconds each moved forward cautiously, avoiding physical encounter, and passed about four feet apart. Each had bluffed the other in what may be the way conflict is avoided many times every night. Intolerance keeps them spread out, which is advantageous for the full utilization of the food supply, and to this end bluffing is as effective as fighting.

Besides these single, intolerant animals, there were others that travelled as pairs, or as family groups. Two that seemed to be a pair uttered low, throaty growls whenever they passed within two feet of each other. Although the growls sounded menacing to the human ear, they were a form of greeting and recognition unaccompanied by act or threat of intolerance. Two minutes after one had left the river and passed under the alders to ascend the hill, the other followed.

These pairs probably were not breeding. Although adult males are capable of mating throughout the year (Asdell, 1946, p. 135), the young of wild California raccoons are born in April and May according to Grinnell, Dixon, and Linsdale (1937, p. 157), after a gestation period of around 63 days (Asdell), which would put the mating season in the early part of the year. Stuewer (1943, p. 61), working with the eastern raccoon, found that "raccoons in the wild are promiscuous. Sexually mature males and females generally den singly. During the mating season, the former travel from one hollow tree to another, apparently seeking receptive mates." Nonetheless, whatever the cause, the attraction within the pairs watched by me was strong. The members of one pair in particular stayed within 50 feet of each other while fishing, and never quarreled. There was none of the fierce snarling that characterized the meeting of intolerant animals. The only audible sound was a low, soft "snore" uttered by the larger one, so low as to be inaudible to me at a distance greater than 30 feet. The sound appeared to be the reassuring affirmation of sociability. Often when passing, the two rubbed against each other, a display of emotion that probably strengthened the bond between them. Noble (1945, p. 93) mentions that "ocelots delight in rubbing against other creatures in whom they have confidence."

After some difficulty I determined that the larger of this pair was a male, the smaller a female. While the female concentrated on fishing, he was attentive to the sounds and smells in the environment. Now and then he reared up in characteristic stance, which, except for the raised snout to test the air and the widely spread front paws, was similar to the "erect standing positions" of the California ground squirrel (Linsdale, 1946, p. 125).

Only the male went after intruders, both possible and real. Once when he had been wading unconcernedly, he climbed up two feet to the top of a boulder in the middle of the stream. There he reared up on his hind legs, pointed his snout high, and sniffed the air. The hind feet were widely spread; the torso vertical. The front feet hung limply down over the chest and abdomen. In-

stead of detecting me, as was my guess, he had heard another raccoon coming from the brushy hillside. Letting out a fierce, aspirated snort-growl, he hurtled over the boulders and lunged into the shrubbery to intimidate and eject the intruder, his speed and impetuosity showing vigor and confidence. Because of the alders I was not able to see the details of what happened, but I heard a bedlam of loud snarls, growls, and grumblings. All I could see was the flashing and dancing of two pairs of shining eyes. Then one pair disappeared back onto the hillside from which it had come. The other returned to the river.

The reason for the male's aggressiveness seemed to be defense of the female rather than defense of area. He watched her almost constantly. He was possessive and attentive. Once when she drew herself out of the water onto a broad boulder where he was squatting, he mouthed her shoulders, after which, as she stepped back into the water on the opposite side, he yawned.

Although the attraction between them was mutual, it was less manifest in the female. She accepted his leadership but maintained a degree of dissociation that made her more independent of him than he was of her. It was he who initiated the movement down-river to the lake. He had been squatting on a boulder in the middle of the stream while the female, as usual, had been fishing. Becoming restless, he waded toward the shore. The female then directed her foraging in his direction. She was willing to follow him so long as she could continue the hunt. For some reason the male was not seeking crayfish but was anxious to depart. Every four or six feet he stopped to turn his head around and look back. If she was coming, even though slowly, he was satisfied.

He left the river and, passing under the alders, climbed up the bank into the shrubbery. The female did not follow. She concentrated on fishing, which was her dominant interest. When the male, again looking back, saw that she was not with him, he returned to the shore and, walking along the bank, kept abreast of her. He made no effort to force her to go where he wanted to go. If she insisted upon fishing he seemed to be willing to wait. When she became so interested in a particular pool that she paused to explore all parts of it again and again, he squatted on a boulder, from which he watched her until, as though bored with waiting, he waded into the water and in 20 seconds captured a crayfish. The female, in spite of her endeavors, had not captured one in five minutes. His proficiency doubtless explained why he had stopped fishing sooner than she had. When I last saw these two they were still moving slowly and leisurely downstream to the lake in the manner described.

At 10:00 p.m. on August 11, 1945, I spotlighted an old female and two half-grown young hurrying downstream along the opposite shore. The young kept close to their parent; whenever possible, right at her heels. The only sound was a constant low grumbling purr by the mother, which I had never heard under any other circumstance.

Another adult and two half-grown young were fishing in a pool. Although the young kept to shallower water than the old one, their fishing technique, otherwise, was the same. They were careful about getting wet: rarely, more than the lower two-thirds of their legs were in water. Their backs were hunched, their tails raised. Sometimes they looked downward, sometimes toward the

opposite shore. They knew how to feel for the crayfish with their paws. Occasionally they stopped at one spot. Then their shoulders revolved as their paws slithered about on the bottom of the pool. More often they were moving forward or backward, or suddenly to one side or the other. They made captures less frequently than their parent, and when she moved on to another pool they followed. These brief observations on the relations between young and parent agree with Stuewer's (1943, p. 70) conclusions "that the female alone cares for the young."

SUMMARY

During the middle of August 1945, and the end of July 1946, California raccoons at San Clemente Lake of the Carmel River, California, were eating crayfish and Eastwood manzanita berries. They were disturbed by the observer's sounds but not by a flashlight. They tended to wander, so that none stayed long at any one spot. They captured crayfish by feeling under water with their paws and ate them on exposed river boulders. Most of them were solitary and intolerant of each other. A few traveled as pairs with a marked degree of mutual attraction. Young following their mothers were seen in August.

LITERATURE CITED

ASDELL, S. A. 1946. Patterns of mammalian reproduction. Ithaca, Comstock Publ. Co.

BAKER, R. H., C. C. NEWMAN AND F. WILKE. 1945. Food habits of the raccoon in eastern Texas. Jour. Wildlife Mgt., vol. 9, no. 1, pp. 45–48.

GILES, L. W. 1940. Food habits of the raccoon in eastern Iowa. Jour. Wildlife Mgt., vol. 4, no. 4, pp. 375–382.

GRINNELL, J., J. S. DIXON AND J. M. LINSDALE. 1937. Fur-bearing mammals of California. Berkeley, Univ. Calif. Press.

HALL, E. R. 1946. Mammals of Nevada. Berkeley, Univ. Calif. Press.

HAMILTON, W. J., JR. 1940. The summer foods of minks and raccoons on the Montezuma Marsh, New York. Jour. Wildlife Mgt., vol. 4, no. 1, pp. 80–84.

INGLES, L. G. 1947. Mammals of California. Stanford Univ. Press.

LINSDALE, J. M. 1946. The California ground squirrel, a record of observations made on the Hastings Natural History Reservation. Berkeley, Univ. Calif. Press.

NOBLE, R. C. 1945. The nature of the beast. Doubleday, Doran and Co., New York.

SETON, E. T. 1909. Life-histories of northern animals. Charles Scribner's Sons, New York.

STUEWER, F. W. 1943. Reproduction of raccoons in Michigan. Jour. Wildlife Mgt., vol. 7, no. 1, pp. 60–73.

WALLS, G. L. 1942. The vertebrate eye and its adaptive radiation. Cranbrook Institute of Science, Bull. no. 19.

WHITNEY, L. F. 1931. The raccoon and its hunting. Jour. Mamm., vol. 12, pp. 29–38.

———— 1933. The raccoon—some mental attributes. Jour. Mamm., vol. 14, pp. 108–144.

YEAGER, L. E. AND R. G. RENNELS. 1943. Fur yield and autumn foods of the raccoon in Illinois river bottom lands. Jour. Wildlife Mgt., vol. 7, no. 1, pp. 45–73.

YEAGER, L. E. AND W. H. ELDER. 1945. Pre- and post-hunting season foods of raccoons on an Illinois goose refuge. Jour. Wildlife Mgt., vol. 9, no. 1, pp. 48–56.

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THE WISENT OR EUROPEAN BISON

By Richard Glover

When Germany collapsed in May 1945, the Allies had teams of experts ready to scour the country in search of the looted art treasures of Europe in order that nothing of cultural value to humanity might be lost. One object of cultural and scientific interest, however, was overlooked. The preservation of the wisent or European bison (*Bison bonassus bonassus*) was largely a German enterprise; it was the Germans who organised the international society for its protection and drew up the stud book. Herman Goering was personally interested and himself owned four purebreds, besides crosses. Perhaps because their preservation was so German an enterprise, the Western invaders, for all their interest in saving civilization and culture, cared not at all for the wisents the Germans had so carefully bred and these rare animals were left to take their chance in a starving continent. Yet the wisent is one of the finest animals on earth and the fact that even the Nazis had the wit to recognise it as such is not to its discredit. Barely a hundred existed at the outbreak of Hitler's war and their neglect seems regrettable.

Many have heard of the European bison, but few have seen it. To get an idea of its appearance, imagine the American buffalo put through such a metamorphosis as might change a cart horse into a thoroughbred. The wisent is higher at the shoulder, with longer legs, and markedly longer from nose to tail; a streamlined animal as narrow in the beam as a red deer with none of the American bisons' barrel-like rotundity; his head is smaller and carried higher, as befits a browsing animal; his hindquarters are tall and well proportioned; because of the height of the rump and carriage of the head his hump seems less pronounced, but is in fact longer than the American's; his well furred tail hangs to his hock; his mane is thinner and the coat on his hindquarters thicker than the American's; his beard is less than the American's and his forelegs, though hairy, have not the bushy "plus fours" of the American bison; he is active and quick on his feet; all in all, as splendid a beast as ever trod the forest and remarkably like the best of the Cro-magnon artists' sketches in the Altamira caves. Beside the fine European bull in the Amsterdam zoo, the nearby American bull is made to look like an overspecialized degenerate.

The wisent became extinct as a wild animal before its habits had been as fully studied as one could wish, and nothing like the literature that has gathered about the American bison is available on it. The most accessible first hand authorities are, first, Dimitri de Dolmatoff (1848), Master of the Imperial Forests of the Government of Grodno in the 1840's who was responsible for preserving the wisents of the Bialowies forest; and secondly, Prince Demidoff (1899) who hunted in the Caucasus in the 1890's. Neither is very satisfying. Dolmatoff was a good observer, but his description is mainly of catching wisents alive and of their care in captivity. Demidoff's frank admission of his numerous misses stamps him as an uncommonly honest sportsman, but he had not the curiosity, the powers of patient observation or training of a naturalist. Thirdly, A.

Yermoloff (1906) published information derived from Grand Duke Sergius Michaelovitch's head keeper in the Caucasus. Fourthly, in the 1928 report of the wisent protection society, P. Westburg published a digest of a paper prepared in 1900 by G. von Westberg and based on twenty years observations at Bialowies.

Dolmatoff's account tells how he caught wisents by order of Tsar Nicholas I, who had promised a pair to Queen Victoria. He gives an eyewitness's description of the calves romping with each other, running to their mothers and then racing back to play again, while the narrow valley in which the group of wisents lay was surrounded by fifty huntsmen and three hundred beaters. Suddenly there came the peal of a horn and the wisents leaped to their feet; then the beating of drums, and the wisents fled, with calves in front and the mothers covering the rear. As they reached Dolmatoff's waiting line of "chasseurs," the men in ambush shouted and fired guns; at once the old wisents charged past the calves to the front, and triumphantly breaking through their foes, rushed on; but one little calf and a fifteen months old youngster were left struggling with the huntsmen who sprang out of hiding when the grown wisents had passed them. The larger youngster successfully shook off eight men, but was run into a marsh by a pack of hounds and so secured.

Three points emerge from this account; first, the herd's danger formation with the youngsters in the safest place (a formation the writer saw so faithfully repeated by a group of cows with one calf among them at Woburn that it was at first not easy to get a good look at the calf); second, the play of the calves in their own community; and, third, the apparent absence of big bulls. Dolmatoff thus does more than describe a hunting scene; he gives, implicitly but truly, a picture of the social habits of the wisent. The mature beasts of different sexes went separately at all times except the mating season; young animals of both sexes stayed with the maternal group which followed the leadership of an old cow. These groups might number from 4 to 30, or, very occasionally, up to 40. No herd of more than 40 was ever observed, says Westberg; and here appears the first contrast of habits between the wisent and its American relative, the vastness of whose herds is notorious. Bulls had even less of the gregarious instinct than cows, and though they associated in loose knit little groups, these readily split up into parties as small as two or three; very old bulls wandered about alone. All this recalls in a striking manner the social habits of the Scottish red deer, so admirably described by Fraser Darling (1937), but the red deer differ in that their separate hind groups at times unite into larger groups. The wisent female group, on the other hand, was a very close family affair and strangers were driven off, or only slowly accepted.

The scene Dolmatoff describes was laid in the Bialowies forest for the wisent is a woodland animal, like all other wild cattle except the American bison; and probably the prairie bison too lived in forests until recent times for it possesses keen scent but weak eyes. Keen eyesight and indifferent scent is the mark of the true plains animal and this fact may suggest that the plains buffalo was a relative newcomer to the prairies on which it was found in such numbers.

The senses of the European bison are likewise bad eyesight and keen scent. An old gamekeeper in the Kuban told Prince Demidoff how wisents on seeing him would sometimes stand and stare, as old travellers report of the American bison; but, added the keeper, "if they got your wind without seeing you, you would hear a tremendous crashing in the bushes and off they would start at a wild gallop." In spite of occasional fits of standing and staring, the wisent was a wilder, warier animal than its American cousin. The American bison was the easiest of game to kill, but the wisent, when truly wild, was almost unapproachable. The first western sportsman to go hunting in the Caucasus was an Englishman, Mr. St. George Littledale (1894), and not till his third trip did he succeed in getting a wisent. The Grand Duke Sergius Michaelovitch was at first equally unsuccessful. Long protection and regular winter feeding went far to tame the wisents at Bialowies, but in clear weather they would be agitated by the smell of a man 150 to 200 paces distant.

A corollary to the wisent's being a forest animal is its need of shade. To cold it is impervious, and even young animals are not affected by hard weather—a calf born in eastern Poland in the end of November 1930 survived the winter and grew into a fine animal; so did a bull calf born in Berlin in January 1929. The wisent enjoys snow and likes to play in it, but strong sunshine drives him to shelter.

The food of wisents, says Demidoff, consists of "grass, ferns and a small plant with very wide leaves that grows in the woods known, I believe, as *Onoclea Struthiopteris*, Hoffman." But being a forest animal it browsed as well as grazed; "they are also fond of the bark of trees, especially birch", adds Demidoff. Dolmatoff, who knew the animal and its needs as well as anyone, fed his captives with the leaves and bark of ash, hornbeam, wild pear, aspen and "autres jeunes arbrisseaux"; and also "du tilleret", which is not in my French dictionary, but probably means the lime, *Tilia europea*. The Berlin Zoo authorities gave their wisents willow and oak loppings, stressing the animal's need of the tannic acid in the bark as well as the vitamin C in the leaf; and in season they gave them acorns too. Yermoloff adds the bark of the elm, *Ulmus campestris*, to the wisent's diet, and says the Caucasus wisents did their grazing at night on the grassy slopes above the tree line, retiring by day to the thick forest lower down. Although wisents in natural surroundings did some grazing, browsing seems to supply food values they cannot do without. At Woburn where the wisents live in wide paddocks with ample space and plenty of good grazing, the writer was told they needed a lot of oats if they were to keep fit; they would hardly need this artificial diet if grazing filled all their requirements. On the other hand, the Springe herd, kept in a 17-acre enclosure in the old park of the Hanoverian kings, is said to have been irregularly fed, and still throve; but the enclosure was deciduous woodland, the normal home offering the normal food supply. This positive need of a mixed diet seems both to offer contrast between the European and American bisons and to make the former harder, or at least more expensive, to keep in captivity.

One can hardly use the word migration of so local an animal as the wisent

has been in recent times, but from Westburg's account it appears that at Bialowies there was some seasonal movement, dictated by food supply and insect pests. In early spring when the first tender grass began to shoot, the wisents sought the meadows that flank the few sluggish streams flowing through the forest. In summer when the insects bothered them, they were to be found in the more open pine groves, especially on the higher and dryer ground where their favorite grass, *Hierochla australis*, grew. In autumn, when the insects were gone, they moved to damper spots among mixed groves of deciduous trees and evergreens where the vegetation was thicker. Winter was a hard time for them and they were then found wherever there was anything to eat; while they did much grazing in spring and summer, browsing was their main support in winter. But they also pawed through the snow after withered herbs and grasses and, in oak stands, after acorns. These very limited seasonal movements within Bialowies offer another contrast to the habits of the American bison whose long and regular migrations are described by Hind (1860) and others. Old wisent bulls, living a hermit life, were great wanderers and sometimes strayed far beyond the bounds of the Bialowies forest into the neighboring provinces of Minsk and Volhynia. Here another parallel may be offered by the red deer which is a spreading and colonising animal in the Scottish Highlands; and there, says Darling, new ground is first occupies by males.

Dolmatoff noticed that wisents did not like dogs and says they "s'acharnen à leur poursuite"; so one would not suppose that the wolf was a serious enemy. Wolves, if they were to have a chance, must catch a lone wisent isolated from the protection of the herd. Then three or four wolves could kill a two-year-old, says Westberg, and five or six could kill a three or four-year-old; and a full grown beast could presumably defend himself against an even larger number. If the wolves caught their wisent on a large and slippery sheet of ice, they had much less trouble in finishing him off. In the Caucasus where the faunas of Europe and Asia meet, Demidoff was told the leopard thinned the wisents' numbers. Perhaps. And perhaps again the leopard was blamed for the pocher's work. Bears were also blamed for preventing the increase of wisents in both Bialowies and the Caucasus, but Westberg says that, when bear and wisent met, it was the bear that yielded right of way. Man was really the only serious enemy of the wisent.

Wisents do not reserve their truculence for dogs alone. When Dolmatoff tried to mingle in a common enclosure some pairs that had been kept separate, the result was a tremendous free-for-all battle, in which the keepers' intervention became necessary to save one cow from three bulls. At Woburn, where the bulls are kept in a separate enclosure from the cows, the younger bulls walk very noticeably in awe of the master bull, especially at feeding time. At Amsterdam, on the other hand, where the big bull had one cow for a companion in his enclosure, the keeper indicated that the admission of another cow would mean war between the females. The bulls are also liable to kill very young calves, and, occasionally, each other.

Wisents live long, occasionally even to the age of 38, says Westberg, but this

is perhaps an exaggeration; Westberg wrote of the free wisents of the Bialowies forest where ages could only be guessed. The captive cow "Plavia" was older than most wisents of which there are accurate records when she died in the Munich Zoo at the age of 26. A natural consequence of longevity is late maturity. Wisents are said to be mature at six, at which age a normal bull should weigh 1800 lbs., but the Duke of Bedford considers that a bull does not reach his full growth much before the age of ten—and probably no man living has seen more wisents grow up; certainly the difference between a six year old (in 1945) crossbred bull ($\frac{7}{8}$ wisent x $\frac{1}{8}$ buffalo) at Amsterdam and the older purebreed would confirm his estimate. A bull reaches puberty at four, says Westberg, adding that at this change of life he developes a musky smell; at this age, too, the young bulls drifted away from the cow groups, usually in early spring when the groups were widely dispersed over their grazing grounds. At four, cows normally came into heat for the first time, says Westberg, although sometimes they did so at three; but here again the recent breeding records of wisents in captivity do not entirely agree with Westberg's observations in Bialowies. Calves have been successfully begotten by bulls less than three years old and born to cows aged but little more than 36 months at parturition.

At Bialowies mating took place in August and September. In this season the bulls broke the silence usual to the wisent with short roars that resounded through the forest; and their battles at that time were a famous sight at Bialowies. Yermoloff says that these fights were never observed in the Caucasus, a statement that seems more a tribute to the wary evasiveness of the Caucasus wisent than acceptable evidence of its non-belligerence. In captivity wisents may breed at any time and the studbook of the International Society for the Preservation of the Wisent records births in every month of the year except February. May and June remain the commonest birth-months for captive wisents but autumn calves are common. Gestation lasts nine months and, according to Westberg, twins occurred very rarely; there is no record of twins born in captivity. The newborn wisent calf is yellow, unlike the newborn American bison, which is red. Yermoloff says the wild cows in the Caucasus kept their infants hidden in the dense rhododendron thickets for six or seven days after birth before they joined the herd; but the first calf born in Count Arnim's park at Boitzenburg in Uckermark (some 50 miles north of Berlin) was seen to follow its mother at a gallop at three days old, so Yermoloff's informant may have exaggerated.

The slowness of the Bialowies wisents' rate of increase was notorious at the start of this century, so much so that some naturalists then attempted to account for their dilatory reproduction with the theory that their fertility was lowered by inbreeding. That theory will not do; for one thing, inbreeding need not cause loss of fertility; for another, the lowest census ever taken at Bialowies showed the herd nearly two hundred strong so it is hard to see how they could be inbred. But it was normal, says Westberg, for the calf to be suckled for two years and suckling so weakened the cow that she commonly calved only once in four or five years, sometimes only once in six or seven years. In the artificial conditions of captivity, with high feeding of the mother and forced weaning of

the child, cows calve much more frequently; "Plavia," for instance, while in the Berlin zoo, had nine calves in the thirteen years between 1911 and 1923, but with the best of care the wisent seems a slower breeder than the American bison. The exceptionally slow breeding at Bialowies, recorded by Westberg, was probably due to underfeeding, as the forest was heavily stocked with deer, which, both in browsing and grazing, competed for the wisents' food supply.

One curious characteristic of the wisent is the periodic shedding of the tail tuft. The wisent's tail is quite unlike the naked and piglike appendage that barely provides a decent covering to the rear end of a buffalo. It hangs to the hock and is well furred—sometimes with short hair like a cow's tail, sometimes with hair so long and bushy as to suggest comparison with a horse's tail (it is interesting that both types of tail are to be seen in the Duke of Bedford's herd). The tuft at the end of the tail grows down below the hock, a close knit mass of long medium brown hair, until sometimes it hangs to the heel, and is then sloughed off and grown again. At Amsterdam the keeper had a bunch of these cast tail tufts hanging on a nail in the main bison shed.

The horns of the cow wisent often make a quarter spiral, forwards, inwards and slightly backwards, like some Ayrshire cows. The Cro-magnon artists caught this curve admirably and anyone at all familiar with their work will be reminded of it on seeing the cow "Artemis" at Amsterdam.

At Bialowies the wisent had the reputation of being a good swimmer and a lover of marshes. In the Caucasus, on the other hand, it proved itself a remarkably active and wide ranging mountaineer; "when frightened they wander great distances without taking rest and are not stopped even by the highest ridges," wrote Demidoff. The Prince also thought it likely that they crossed the main range in the Kuban district, for he had seen their tracks in the snow in September at 8000 feet and had reports of their existence on the southern slopes of the mountains. With its heavy forequarters and feeble hind legs the American bison made poor time when pursued uphill; the wisent's tall hindquarters and length of limb would be as much to his advantage in steep country as his narrowness of beam in close timber.

The survival of the wisent into the twentieth century was due to the Tsar's game laws. Its two historic habitats, as noted, were the Forest of Bialowies and the Caucasus. Bialowies became Russian when Catherine II annexed the province of Grodno at the Third Partition of Poland in 1795. An ancient hunting preserve of the Polish kings, Bialowies had long been a sancturary for the wisent. At first the enforcement of game laws was relaxed under Russian rule and the wisents suffered, but among the earliest acts of the Tsar Alexander I was the reorganization of the game wardens and provision of fodder for the animals in winter (1802). An Englishman, E. N. Buxton (1899), who visited Bialowies in the 1890's, describes it as a typical example of continental forestry, cut by regular rides at right angles and kept very tidy; too tidy, thought Buxton, who considered that the windfall timber the foresters cleared away would give the animals valuable shelter. Buxton took some photographs of wisents (a remarkable achievement, one feels, with a camera of that date); noted that the

timber was mainly oak, elm, birch, spruce and fir; and expressed his doubts as to whether the censuses of the wisents that the foresters periodically took were in the least degree accurate. As the forest covers some 376 square miles (nearly twice as much as the Wainwright Buffalo Park) it cannot have been a small or easy task to count the animals. In 1914 the census takers reckoned there were 727 wisents in the forest. These were soon reduced by poachers after the outbreak of war in August 1914 and were exterminated in the lawlessness of the Russo-Polish War of 1919–21. The name of one Bartholomaus Schpakowitch goes down in history as the slayer of the last Bialowies wisent in February, 1921.

The wisents of the Caucasus were hardly known outside Russia until the Englishman Littledale went hunting there and gave the skins of a male and female to the British Museum. These wisents ranged over some 2000 square miles on the northward slope of the mountains, about the headwaters of the Bielaja and Malaja Laba rivers (confluents of the Kuban). The Russians did not secure full control of their territory until about 1860, after which they early instituted a strict protection to which the native Tcherkesses did not take kindly. The local sporting rights were secured first by the Grand Duke Michael Nicolaevitch and then by the Grand Duke Sergius Michaelovitch. These noblemen did their best to make the protection of the wisents a reality by providing gamekeepers and were themselves not allowed to kill one without express permission of the Tsar, nor was permission ever given to kill more than three in a season. Under these conditions the Caucasus wisents naturally increased, but for them too the Kaiser's War was fatal. The Grand Duke's protection was a grievance to the local herdsmen and the Revolution removed his keepers. The last word of living wisents in the Caucasus came in 1924 when 25 individuals were reported as surviving. After this report the Soviet Government was quick to declare the wisent a protected beast and its range a sanctuary, but slow to implement its decree. It was not till 1927 that they investigated the situation. Then they sent to the area a party led by a Dr. Filatov, who had studied the wisent there before the War, and including one M. P. Rosanow, former director of a shortlived Crimean Wisent Reserve (established in 1914), and a Daniel Siedun, former gamekeeper at Bialowies—a strong team. They searched the area thoroughly but not one live wisent did they find. There were plenty of signs of wisents left—dried dung, trees with the bark gnawed in the animal's characteristic manner and skeletons with which bears had made merry; but more than one bullet-drilled skull bore witness that it was not the bears that had killed the wisents.

The loss of these last animals is particularly regrettable because the Caucasus Wisent is generally considered a distinct geographical race. It differed from the Lithuanian Wisent of the Bialowies Forest in having a smaller hump and hence less height at the shoulder; it was shorter in the body; its head was heavier; its general build more compact. These characteristics are well shown in the photographs of "Kaukasus," the only living Caucasus wisent to leave Russia, and in the photograph of a Caucasus wisent in the St. Petersburg Museum that illustrated Yermoloff's article. Count Arnim, who bought "Kaukasus" and

his daughter (by a Lithuanian cow) to found his herd at Boitzenburg, had made the observation that a pure Lithuanian cow he added later had a smoother coat than the Caucasus animals. These differences of build and proportion seem to make a greater distinction between the Caucasus and Lithuanian wisents than exists between *Bison bison bison* and *Bison bison athabascae*.

Outside Russia a large herd of captive wisents lived in the spacious confinement of the Prince of Pless's park in part of Upper Silesia that became Polish by the much abused treaty of Versailles. This herd sprang from one bull and four cows imported from Bialowies in 1865 and reinforced by five more cows in 1893. In 1918 it numbered ninety odd; when law and order replaced the chaos that arose out of Germany's defeat only three animals survived.

In the inter-war period the owners of the few wisents surviving in parks and zoos united to form the International Society for the Preservation of the Wisent. They had some 60 animals to work with, representing four strains; first, the "Bialowies strain" being the most recent exportations from Bialowies and their off-spring, mainly in Vienna and Sweden; second, the "Pless strain," reduced to one old cow and two young bulls (the younger lamed by a poacher's shot and useless for breeding); third, the old "Zoo strain," being animals long bred and born in close captivity; fourth, the "Caucasus strain," that is, the bull "Kaukasus" and his descendants by cows of the Lithuanian race. Ideally, these strains should have been bred within themselves, for two reasons; first, to preserve as much as possible the distinct geographical races of Lithuania and the Caucasus; second, so as to build up separate strains that could refresh each other if ever weakness due to inbreeding appeared, and not to mix them up first and then have no possible outcross if ever inbreeding should have ill effects later. This policy was outlined, but not followed.

The chance of preserving the Caucasus race, represented by the one bull, "Kaukasus," and his half Caucasian offspring, was obviously slim. Count Arnim of Boitzenburg seems to have wished to attempt it when in 1921–22 he bought "Kaukasus" and his two living daughters. But "Kaukasus" was old; at Boitzenburg he begot one heifer by his daughter "Hagar" before he was supplanted as breeding bull by a grandson purchased out of the von Beyme herd. When "Hagar" and her daughter sickened and died in 1924, all hope of preserving anything very representative of the Caucasus race was gone. But if the Caucasus race was unable to perpetuate itself, it went far to obliterate the pure Lithuanian race. "Kaukasus's" son "Hagen," and his offspring begot an extraordinarily high percentage of bulls, who carried their Caucasus blood in varying degrees of dilution into every herd but that at Pless. The last chance of continuing the "Bialowies strain" perished when (almost appropriately) the last young Bialowies bull was killed by an older bull of the Caucasus line (a tragedy that took place at Bialowies in 1935); and by the late 1930's the "Zoo strain" was represented by only a handful of animals at Berlin.

If not carried out on ideal lines, breeding went ahead, nevertheless, but the increase was slow. Some animals surviving in 1919 were old and either barren or soon to become barren; foot-and-mouth disease killed Hagenbeck's animals

in 1925 and the von Beyme herd in 1926; the injudicious mating of purebred wisent cows to bastard bulls with the blood of domestic cattle in their veins also delayed the increase of the true wisent. Yet the Pless herd made a remarkable recovery. As mentioned above, its effective breeding stock after 1919 amounted to one young bull and a cow born in 1904; this aged cow obligingly produced three calves, the last when she was twenty two. One of them was a female from whose matings with her father and brother sprang a new herd which in 1936 numbered nine bulls and eight females—four cows, two yearling heifers and two heifer calves. The wisents at Boitzenburg, whose proportion of Caucasus blood averaged nearly 30%, also throve, although there many more bull calves than heifers were born. Between 1929 and 1935 the Polish government bought a Boitzenburg bull and the three cows and young bull of the "Bialowies strain" from the Swedish herd to restock the forest of Bialowies, and there too the animals throve in an enclosure of some 140 acres. The loss of the Swedish bull was made good by the purchase of a young bull of the pure Lithuanian herd at Pless. In 1934 the Prussian government established the wisent park at Springe (Hanover) with a fine bull from the Berlin Zoo and with Count Arnim's three best cows from Boitzenburg. The Swedish herd at Skansen was refounded in 1935 with two cows out of the increase of the new Polish herd at Bialowies which were pregnant to the Poles' stud bull when shipped; their mate in Sweden was a young bull bred at Skansen by a Boitzenburg sire out of the last of the Bialowies cows to leave the country. The zoos at Berlin and Amsterdam also had a breeding pair or two. In January 1937 there were 84 living purebred wisents. Although the total was small, many of the animals were young, their needs were well understood, and their breeding well organized.

It is well known that besides the breeding of purebred wisents the more dubious policy of breeding crosses was carried on. Before the Kaiser's war some hybrids between wisents and grey cattle of the southern steppes had been exported from Russia. Hideous animals these hybrids are, with sharp "ridgepole" backs, bulging potbellies, long, weedy necks and weak, thin horns with an exaggerated curve; but such as they were, the aim of the crossing policy was to use them to breed back to the wisent by mating the females, and American bison cows, to pure wisent bulls, with whom in due course the resultant female offspring were mated again. This "breeding back" process takes a long time. German authorities reckoned the true wisent type would be achieved in from five to seven generations. Certainly the third generation crosses at Amsterdam with only $\frac{1}{8}$ of American blood do not look right as they stand caged beside the genuine article. Still, it was an attractive idea, but unfortunately the male bastards were not always killed or castrated and, as mentioned above, some pure wisent herds were contaminated by their use as sires. The chief "breeding back" studs were at Ascania Nova in southern Russia; at Schorfheide in Germany; at Spala, near Cracow, in Poland; at Langsjon in Sweden; and unfortunately the Duke of Bedford's herd at Woburn must be classed with these crossed herds. A tragic chapter of accidents, including lightening, destroyed all of the late Duke's five purebred bulls between 1934–36, and, as British regulations against

foot-and-mouth disease forbid the importing of wild ungulates, he was left with only a bastard bull to use for breeding; the percentage of cattle blood in this herd, however, is very low (not more than 3⅛%).

I have to thank Miss Erna Mohr, archivist of the International Gesellschaf zur Erhaltung des Wisents for a statement of the purebred wisent's status as of January 1, 1947. It makes happier reading than might have been expected.

	Males	Females
Poland & Russia	24	26
Holland	1	3
Germany	11	14
Sweden	11	6
Switzerland	1	0
	48	49

Finally the writer wishes to thank the Duke of Bedford for his kindness in showing him the Woburn herd.

LITERATURE CITED

Buxton, E. N. 1899. Communication about the Forest of Bialowies. Proc. Zool. Soc. London, p. 64.

Darling, F. 1937. "A Herd of Red Deer". Oxford.

Demidoff, Prince Elim Pavlovitch, of San Donato. 1899. Hunting Trips in the Caucasus. London.

Dolmatoff, M. Dimitri de. 1848. Note on the Capture of the Aurochs. Proc. Zool. Soc. London, pp. 16–20.

Hind, Henry Youle. 1860. Narrative of the Canadian Red River Exploring Expedition of 1857 and of the Assiniboine and Saskatchewan Exploring Expedition of 1858. London.

Littledale, St. George. 1894. Essay on Wisent hunting in the Caucasus in the Badminton Library, "Big Game Shooting". London.

Yermoloff, A. 1906. The Bisons of the Caucasus. Ann. Rept. Smithsonian Inst.

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THE SEXUAL CYCLE OF THE MALE LONG-TAILED WEASEL (*MUSTELA FRENATA*)[1]

By Philip L. Wright

Some aspects of the sexual cycle of the long-tailed weasel have been reported in previous papers (Wright, 1942 a and b). Breeding takes place during the summer months, followed by ovulation, fertilization, and cleavage, but implantation of the embryos does not occur until less than 27 days before the young are born the following April or May. Both the young females three or four months old and the adult females breed during this summer season and all females taken in the fall or winter were found to be pregnant. A correlation was found to exist between the time of the onset of the spring molt from white to brown and the birth of young, the former preceding the latter by about 47 days. In males the testes which are aspermatic and inactive during the fall and winter were found to begin to increase in size and undergo spermatogenesis at about the time the spring molt begins and at the conclusion of the spring molt, usually in April or May, the testes have reached maximal size. The purpose of the present paper is to contribute more data on the sexual cycle of the male weasel.

MATERIALS

Data are available from about 30 males maintained in captivity and from about 50 males preserved when killed in 10% formalin. Several of these specimens were found on the highway freshly killed by automobiles, others were taken by trappers. Most of the specimens both dead and alive were taken in western Montana and belong to *Mustela frenata oribasa* (Bangs) (Hall, 1936). Other specimens came from Idaho, North Dakota, Minnesota, Wisconsin, and Washington. Some of the captive animals were born in the laboratory and others were shipped in alive by trappers. For the most part the data from captive animals conform closely to data from wild animals. A few captive animals failed to display the usual molts at the normal time and since this failure of molting was often associated with irregularities in the sexual cycle, consideration of these animals is excluded from this report.

The preserved specimens were weighed. Correction values were used to correct the figures of body weights for animals preserved after being skinned and for animals soaked in formalin with the skins intact. The testes were removed, weighed, and sectioned; the baculum removed, cleaned, air dried, and weighed; the skulls removed and cleaned. The captive animals were maintained as previously described (Wright, 1942 b).

ACKNOWLEDGMENT

Dr. William L. Jellison very kindly donated several valuable specimens which he collected. Several students and friends too numerous to mention contributed other specimens.

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RESULTS

Baculum weights were obtained from most wild caught animals and from those that died or were killed in the laboratory. It is apparent from the weight data plotted in Figure 1 that the bacula are of two types with respect to weight, and examination of the photograph (Plate 1, lower) clearly shows the bacula to be of two types with respect to appearance. All animals known to be juveniles exhibited the small type baculum, while all animals in active spermatogenesis or those captive animals known to have been in active spermatogenesis at some time in the past exhibited the large mature type baculum. All animals that have died or have been killed in the laboratory have been checked on this point and no exceptions have been found. Deanesly (1935) pointed out the usefulness of differences in baculum weights in the stoat (*Mustela erminea*) as a means of

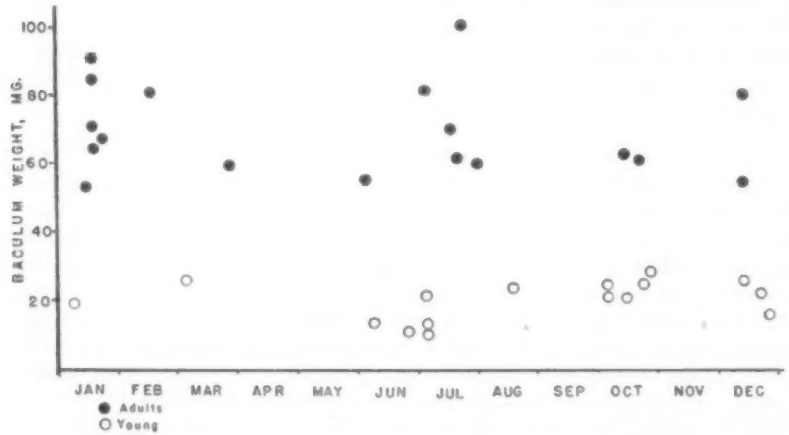

FIG. 1. Weights of os penis or baculum of adult and young of *Mustela frenata oribasa* throughout the year.

distinguishing the adult from immature animals. She believes that the baculum changes from the immature to the adult type in a period of a month when active spermatogenesis starts for the first time. In this work the weight of the baculum has been used as a criterion for distinguishing the adults from young weasels. Since, as will be pointed out later, the young male does not begin to undergo spermatogenesis until the spring following its birth, the young males can be distinguished from the adults throughout the winter and until early spring when they are about 11 months old. In this particular subspecies, young males have bacula weighing between 14 and 29 mg; adults, between 53 and 101 mg. There is no evidence of overlap. Specimens of *M. f. nevadensis*, a smaller form from Idaho, have smaller bacula, while specimens of *M. f. longicauda*, a larger form from eastern Montana and North Dakota, have bacula larger than those of *oribasa*.

The corrected body weights of the western Montana animals killed in the field are plotted in Figure 2. The first juvenile animals were taken in June, and their body weights indicate they are still growing. It is apparent from observations on animals reared in captivity that these wild-caught young males in June are about 8 to 10 weeks old. In late summer the wild caught young males closely approximate the adults in body weight. One young male born in captivity on May 25 had reached its adult body weight when first weighed on August 16 (83 days old). Three of four males in another litter born on March 19 had reached their adult body weights on June 9 (82 days), the fourth male gaining less than one percent after this date.

Although these animals in captivity have reached adult weights at less than three months of age, animals killed in the wild appear to be somewhat smaller during their first year of life and it was of interest to see if this apparent difference

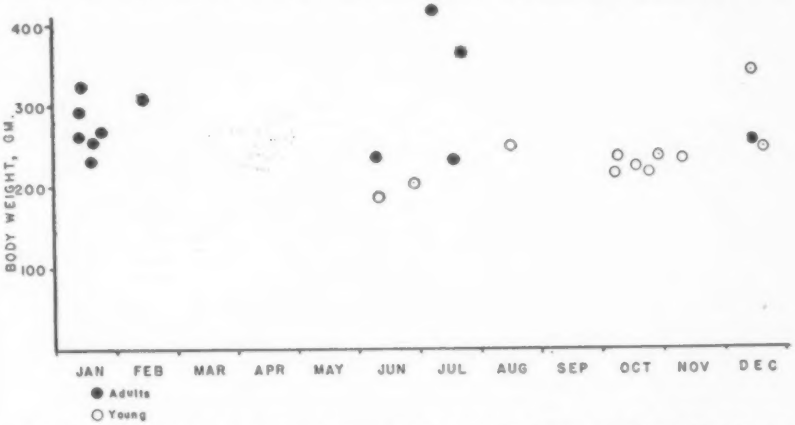

FIG. 2. Body weights of adult and young males of *Mustela frenata oribasa* killed in the field.

was real. Accordingly the body weights of wild-caught males taken in western Montana were analyzed by Fisher's t test as described by Snedecor (1940). The mean weight of the young males was 238 grams; that of the adults, 287 grams. The difference yields a value of t of 2.30, the value of t for the 5% level being 2.08. In other words, the chances of this observed difference in body weights being due to chance alone where no real difference exists is less than 1 in 20. The wide range of body weights and the overlap shown make it apparent, however, that body weight alone is not a reliable criterion for distinguishing adult from young weasels during the fall and winter months. A differential in body weights in females appears to be lacking, since young females in the wild as well as in captivity reach their adult weight in three or four months.

Figure 3 summarizes the data on testis and epididymis weights from all wild caught animals killed in the field, as well as from a few captive animals whose testes were removed by operation. The weights as recorded show the combined

weights of both testes and epididymides after removal of the tunica vaginalis. Unless otherwise stated the term "testis weight" will be used in this paper to mean the testis plus epididymis weight. As in other carnivores the testes in this species descend at an early age and remain in the scrotum throughout life.

As can be seen from Figure 3, the testes of young males taken during the breed-

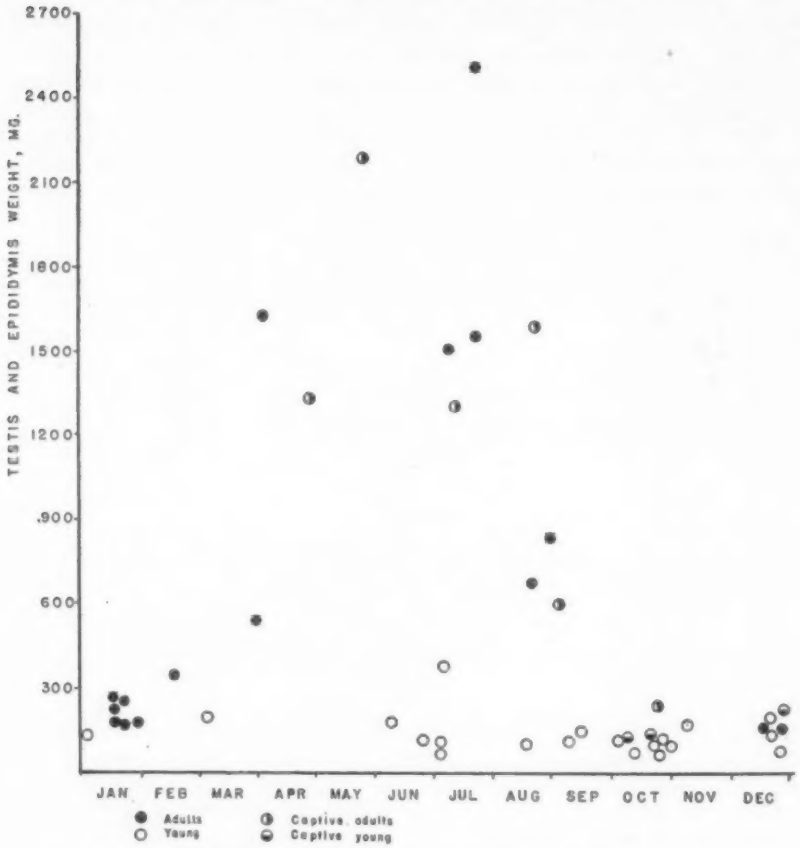

FIG. 3. Seasonal variation in combined testis and epididymis weight.

ing season in mid-summer are small in size, mostly weighing less than 200 mg. No sperm have been found in the testes of any young males during the summer; in fact most of the cells of the seminiferous tubules are spermatogonia, or Sertoli cells. Examination of several captive young males during their first summer indicated no evidence of increased testis size. The testes of these young males remain at minimal size through the fall and winter. In early spring as the 10

to 11 months old male starts the spring molt from white to brown, its testes start active growth and spermatogenesis begins. After full spermatogenic activity is reached, the animal is considered adult. It may be seen that adults show enlarged testes from late March until August. The increase in the testes from the minimal size in winter to the breeding condition is reached over a period of about six weeks (Wright, 1942 b), this being determined from periodic examination of captive animals during the spring period. Sperm are abundant in the epididymides of adult males from April through August, and the adult males are probably fertile through these five months. Histological examination

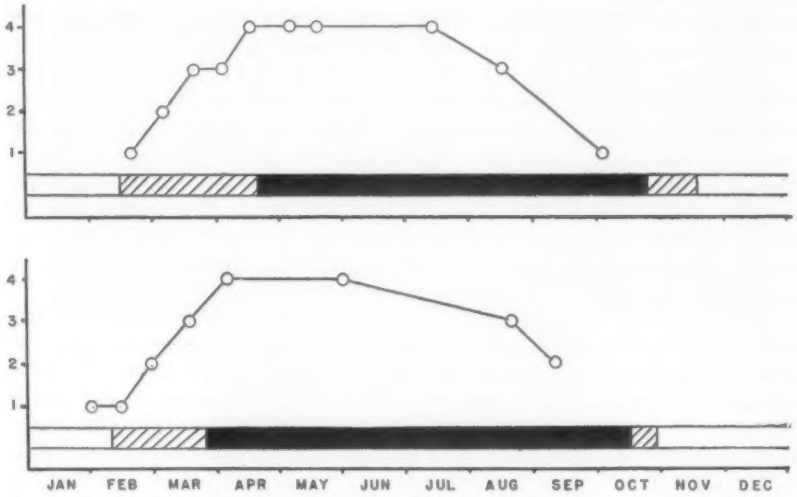

FIG. 4. Seasonal variation in testis size in two captive animals shown correlated with the status of the pelage. Each circle represents the state of testis size as determined by palpation while the animal was under ether anesthesia. The black bars represent the periods the animals were in summer pelage, the white area the periods in white winter pelage, the crosshatched areas in the spring the periods of spring molt, the crosshatched areas in the fall the period of fall molt.

of ovaries and uteri of wild caught females indicate July to be the principle breeding period in western Montana at least.

The testis cycle has been studied in captive animals by periodic examination of numerous males under ether. As described previously (Wright, 1942 b), I can readily distinguish four stages in testis size by palpating the scroral region of males while they are under ether. Stage 1 represents the fully regressed or minimal size, stages 2 and 3 represent larger sizes, and stage 4 represents the maximal testis size. An adult male of *oribasa* when its testes are at maximal development will have a scrotum measuring about 22 mm (laterally) by 15 mm (longitudinally). Figure 4 shows the results of periodic examination of the testes of two males through the period of sexual activity as well as the status of

the pelage in these same animals. The upper figure shows the changes in animal no. 74, the lower in animal no. 28. Both of these were born and reared in captivity, and the data on testis size recorded in Figure 4 are from the year immediately following their birth. The figures indicated are typical of those of adult male weasels maintained in captivity when the molts occur at the usual time. I have been able to see no difference in the testis cycle in animals in the third, fourth, or later years of their lives as compared with their first period of sexual activity.

Earliest signs of spermatogenic activity are seen in the testes of a yearling wild caught animal killed on March 8. This animal was just beginning the spring molt. Its testes show numerous primary spermatocytes in synezesis, but there are no further stages. The seminiferous tubules have increased in diameter considerably. This animal, still with the immature type baculum, is the oldest animal in my series still recognizable as one born the previous season. Another male taken on March 6 was castrated on March 11 when it was just starting the spring molt. Its testes show numerous primary and secondary spermatocytes and spermatids; a few sperm heads are forming. Another animal killed in the wild on March 30 had testes weighing 530 mg, about twice the inactive size. All stages in spermatogenesis are found here but sperm are not yet abundant. There are a very few sperm in the head of the epididymis, but most of the tubules are still without sperm.

An animal taken on April 2 shows testes and epididymides weighing 1674 mg. Histologically it appears very much like the preceding. There are very few sperm in the epididymis and this animal is definitely not yet fertile. A testis obtained by operation from an adult male on April 29 indicates a total paired testis and epididymis weight of 1342 mg. This testis is fully active with sperm being produced throughout it. The epididymis is packed with sperm. This animal started the spring molt on April 4. A testis obtained by castration on May 25 from an animal which started the spring molt early in March indicated a paired testis weight of 1888 mg, the paired epididymis weight being 336 mg for a total combined weight of 2224 mg. This testis like the immediately preceding one is fully active with abundant sperm throughout both the testis and the epididymis. Several testes from adults obtained during June and July are fully active and appear much like the one of May 25.

A wild caught animal taken on August 25 shows testes considerably regressed and no longer producing sperm. There are a few sperm in the epididymis. Another adult male taken on August 31 shows partly regressed testes which are no longer producing sperm. Sperm are absent from the head of the epididymis but are still abundant in the tail and in the base of the vas deferens. A captive adult male killed in October when about half way through the fall molt to white shows testes fully regressed and weighing 284 mg.

The inactive testes of adult males during the winter months do not differ materially from those of young males during the same period. Most of the testes from animals taken during the winter are not well enough preserved to allow detailed study of histological detail.

Adult and young males can be easily distinguished on the basis of this difference in testis size during the summer months and until regression of the testes in the adults is complete in September. Since the young females are definitely known to come into heat during their first summer (Wright, 1942 a), it is apparent that a situation of polygyny must prevail.

Whether or not the testes of adults regress to the size of those of the young males during the fall and winter months is not quite apparent from study of the data in Figure 3. Accordingly, the testis weights of wild caught adults taken during the winter months were compared statistically with the testis weights of

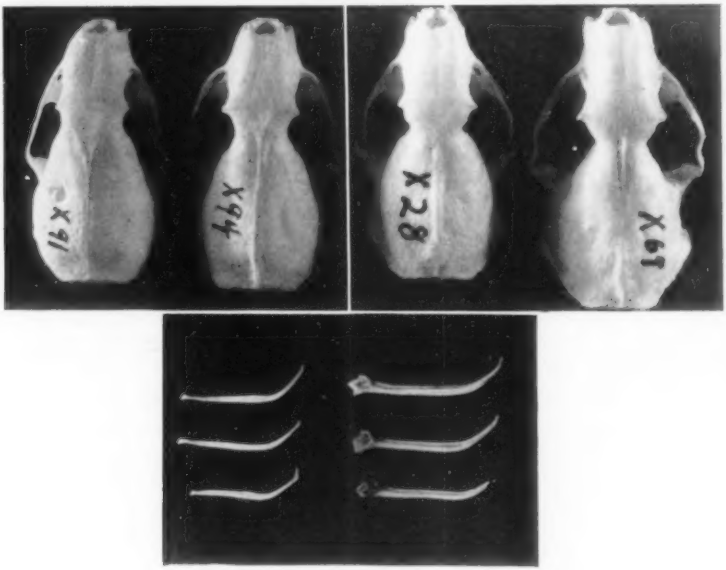

PLATE 1

Upper: photographs of representative skulls of males of *Mustela frenata oribasa*. See text for descriptions of the skulls.

Lower: photographs of bacula of male weasels. Those on the left from young males, on the right from adults. Slightly reduced.

young males. The mean weight of 15 testes of young males was 171 mg; that of the winter testes of 8 adult males was 236 mg. Analysis by the t method yields a value of t of 2.31 as opposed to t for the 5% level of significance of 2.08 indicates a real difference. The testis weights of the adults during the winter so closely approach those of the young males that the two ages cannot be distinguished by this minor difference. Whether or not there are characteristic histological differences in the winter testes of young and old weasels is not apparent from this material. The captive adult male killed on October 28 mentioned above shows a thicker connective tissue capsule and also a more conspicuous basement mem-

brane in the seminiferous tubules, which Deanesly (1935) has found to be a distinguishing character of testes of adult and young males during the fall months in *Mustela erminea*.

Hamilton (1933) has described the early changes in the dentition, and diagrams changes in the skull in the New York weasel (*Mustela frenata noveboracensis*). The permanent dentition is complete at 75 days, he finds. He pictures two skulls of males, one 8 months old and one older than two years in which there are differences in maturity from which one might imply that these differences could be used to distinguish young from adults at least until the young are 8 months old. Representative skulls obtained in this work are illustrated in Plate 1, upper. No. 91 was killed in the wild on June 27 and its skull shows the rounded cranium of the young animal. The saggital crest is inconspicuous, the temporal crests make a deep V, and the lambdoidal ridge and the postorbital processes are not well developed. This animal is probably about ten weeks old. No. 94 is from a young male killed in the wild on October 23 and is probably about six months old. Several other skulls of young males killed in the fall and early winter look very much like this one. In comparison with the younger stage, the dorsolateral walls of the cranium of the adult are more flattened, the saggital crest well developed, the temporal crests form a shallow V, the lambdoidal ridge and the postorbital processes better developed, and the postorbital area constricted. No. 69 is from a male killed in the wild in February; this animal had the large type baculum, and is believed to be at least 22 months old. With the exception of larger size, better developed lambdoidal ridge, and slightly greater postorbital constriction, it differs little from no. 94. No. 28 was born on April 16, 1940, and died in October 1946 when $6\frac{1}{2}$ years old. Its skull differs little from no. 94. It is apparent, then, from this material that by the time the young male of *Mustele frenata oribasa* is 6 months old cranial characters are not of great value in distinguishing adults from young animals. Generally speaking, large males develop more conspicuously the characters commonly associated with age whereas small males, although equally advanced in age, do not develop these characters.

DISCUSSION

Extensive studies of the sexual cycles of male mustelids have apparently been made only by European workers. Allanson (1932) studied the cycle in the male ferret, Hill (1939) studied the male cycle in the European weasel (*Mustela nivalis*), and Deanesly (1935) studied the sexual cycle of both male and female stoats. Watzka (1940) also studied the sexual cycle of the stoat in Germany, but he was interested primarily in the female. Lavrov (1944) also studied the sexual cycle of the stoat. In *Mustela nivalis*, which may have two litters a year, Hill (1939) finds that males born in April reach sexual maturity at four months of age, but those born in July or August do not reach sexual maturity until the next spring when they are seven or eight months old. The testes of most animals in their second year of life are active from March to August, but some are active in February and some into October.

In the stoat, Deanesly (1935) finds that all of the young are born in the spring,

mostly in April, and that males show no signs of sexual maturity until the next spring at which time they come into spermatogenesis. Thus sexual maturity is reached at an age of about 11 months. Most adult males are sexually active from March until August. Watzka (1940) and Lavrov (1944) concur with respect to the major points of the male cycle in this species. These two latter workers and Deanesly (1943) find that breeding occurs in April, May, or June, rather than in July as for *M. frenata oribasa*. The situation in the male ferret (Allanson, 1932) is much the same as in the stoat and the long-tailed weasel in that young males reach sexual maturity in the spring of the year following their birth. Adult male ferrets are sexually active from March until August.

Since the first signs of activity in the resting testes in *M. frenata* occur at about the time of the onset of the spring molt, it is of interest to see if this also occurs in the ferret and the stoat. Deanesly (1935) showed that the testes of the stoat begin to show signs of activity about February 1. She gives little data on the state of the pelage in her specimens, but data on the time of molt in stoats from the British Isles are available from Salomonsen (1939). He found that the fall molt starts after November 1 and is more often than not only partially complete. The spring molt begins about February 1, at precisely the same time relative to the beginning of spermatogenesis as in *M. frenata*. Bissonnette (1935) states that some of the winter coat of the female ferret is shed just before the young are born. In the only male ferret I have used, the testes were fully developed for several weeks before it began to shed its winter coat.

Lyman (1943) worked with the effect of light on the molt cycle in the varying hare (*Lepus americanus*). He found that when hares are in the white winter coat they are sexually inactive and that when they are in the brown coat they are sexually active. That the same situation is essentially true in the male weasel is readily seen from the above data. It was previously shown (Wright, 1942 a and b) that females of *M. frenata* are sexually inactive during the winter months in that they are not in estrous or in active pregnancy, but they are carrying unimplanted embryos at this time. Lyman further suggests that in the hare the presence of gonadotrophic hormones may produce the brown summer coat and that the lack of them causes the winter coat. Perhaps a parallel situation prevails in the long-tailed and other species of weasels, but experimental proof is still lacking.

SUMMARY

In *Mustela frenata* where one litter of young is born annually, most commonly in April, the young male closely approximates but does not usually reach the adult body weight during the summer. The young male remains sexually immature during this summer even though its litter mate sisters will reach a state of estrous and become impregnated by the adult males. By November the young male becomes distinguishable from the adult only by a difference in the weight of the baculum. In early spring all males show marked and rapid changes in their reproductive tracts, active spermatogenesis starting in March. The testes of adults are at maximal size and are conspicuous in the scrotum from

April through July. A gradual regression takes place starting in August and extending into September. By October the testes may be fully regressed and the molt to white may start during this month. The white winter weasel is sexually inactive. The testes of the sexually active animals in late spring and early summer are some 7 or 8 times the size of the fully regressed testes.

LITERATURE CITED

ALLANSON, M. 1932. The reproductive processes of certain mammals. III The reproductive cycle of the male ferret. Proc. Roy. Soc. B., vol. 110, pp. 295–310.

BISSONNETTE, T. H. 1935. Relations of hair cycles in ferrets to changes in the anterior hypophysis and to light cycles. Anat. Rec., vol. 63, no. 2, pp. 159–168.

DEANESLY, R. 1935. The reproductive processes of certain mammals. IX Growth and reproduction in the stoat (Mustela erminea). Phil. Trans. Roy. Soc. London B., vol. 225, pp. 459–492.

——— 1943. Delayed implantation in the stoat (Mustela mustela). Nature, vol. 151, pp. 365-367.

HALL, E. R. 1936. Mustelid mammals of the pleistocene of North America. Carnegie Inst. Wash. Pub., No. 473, pp. 41–119.

HAMILTON, W. J., JR. 1933. The weasels of New York. Amer. Midl. Nat., vol. 14, pp. 289–344.

HILL, M. 1939. The reproductive cycle of the male weasel (Mustela nivalis). Proc. Zool. Soc. London B., vol. 109, pp. 481–512.

LAVROV, N. P. 1944. Biology of ermine reproduction (Mustela erminea L.) Trans. Centr. Lab. of Biol. of Game Animals. People's Commisariat for Procurement, U. S. S. R. vol. 6, pp. 124–149. (In Russian with English summary.) (Only abstract seen.)

LYMAN, C. P. 1943. Control of coat color in the varying hare Lepus americanus Erxleben. Bull. Mus. Comp. Zool., vol. 93, pp. 393–461.

SALOMONSEN, F. 1939. Moults and sequence of plumages in the rock ptarmigan [Lagopus mutus (Montin)]. Videnskabelige Meddelelser fra Dansk naturhistorisk Forening, Copenhagen, vol. 103, pp. 1–491.

SNEDECOR, G. W. 1940. Statistical methods applied to experiments in agriculture and biology. Collegiate Press, Inc. Ames, Iowa.

WATZKA, M. 1940. Mikroscopisch-anatomische Untersuchungen über die Ranzzeit und Tragdauer des Hermelins (Putorius ermineus). Ztschr. f. mikr.-ant. Forsch., bd. 48, ss. 359–374.

WRIGHT, P. L. 1942 a. Delayed implantation in the long-tailed weasel (Mustela frenata), the short-tailed weasel (Mustela cicognani), and the marten (Martes americana). Anat. Rec., vol. 83, pp. 341–353.

——— 1942 b. A correlation between the spring molt and spring changes in the sexual cycle in the weasel. Jour. Exp. Zool., vol. 91, pp. 103–110.

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NOTES ON THE ARCTIC HARE

By Lawrence H. Walkinshaw

On June 4, 1946, accompanied by my son Jim Walkinshaw and a friend, John J. Stophlet of Toledo, Ohio, I landed on the Johnson River, Alaska, about 30 miles west of Bethel and about 20 to 30 miles from where the Johnson River empties into the Kuskokwim River. We stayed in the Reindeer Service Cabin from that time until June 20 when I left. John and Jim remained until June 22. A study of the birds of the region was made while there. On June 20 I flew to the region of Chevak, along the Kashunuk River near Hooper Bay where I spent the next two days. Then I followed up the Yukon to Marshall and back to Bethel.

During the entire time on the tundra we saw no reindeer. Only bones and skulls remain in the region of Johnson River. According to the Eskimos, the reindeer have gone. They blame wolves for the disappearance but have no proof. Regardless of how they have disappeared, it does seem pathetic that such a valuable food species as the reindeer should disappear.

The only mammals observed in the Johnson River region were the red fox (*Vulpes alascensis*), muskrat (*Ondatra zibethica*), and the Arctic hare (*Lepus othus*). During 165 hours in the field I observed only seven Arctic hares. Usually they were loping over the tundra in the distance, their light underparts flashing, and their large hind feet conspicuous. On two occasions, I flushed a lone Arctic hare from a semi-open brushy area where willows and alders predominated.

On June 10, the weather was rainy. Toward evening the rain lessened and we decided to get out for a short time. When about a mile from the cabin, I noted a group of seven small rabbits, cuddled together side by side in a nest. Calling John and Jim, we examined them closely, as well as the location of the nest and the vegetation surrounding it. Photographs were taken by flash even though it was 9:30 p.m. The highest temperature for Bethel on June 10 was 44°F.; the lowest, 37°F. The highest wind velocity for the day was 25 m.p.h., and there was no sunshine. The previous four days and the four following days were cloudy with rain or traces of rain.

The nest was located in a naturally hollowed-out spot in a ravine-like slope facing east. There was no brush for several hundred yards and then only a few bushes. The predominant plant was moss, through which grew large cotton sedge (*Eriophorum angustifolium*). Close to the nest was Alaska tea (*Ledum decumbens*), alpine bearberry (*Arctostaphylos alpina*), dwarf birch (*Betula* sp.), salmonberry (*Vaccimium vitis-idaea*), blueberry (*Vaccinium ulginosum*), crowberry (*Empetrum nigrum*), and numerous lichens. The nest was a mere depression in the moss and cotton sedges. There was no lining. The nest was well packed down where the mother had been laying. The backs of the young were well beneath the top of the surrounding tundra, but the cold windy rain was driving over them continuously.

On June 10, when the nest was found, we did not observe the mother. On June 12, John Stophlet and Jim Walkinshaw observed her as she came over the ridge toward the nest, but she quickly turned back over the hill when she saw them. At no other time was she seen near the nest on our numerous daily visits.

The young, when first examined, had about two inches of umbilical cord attached. Although they were more interested in keeping warm by crowding closely together, they showed fear when we picked them up, but soon cuddled against the others if replaced in the nest. We left them that night but decided because of Jim Walkinshaw's desire to try and raise one, to get one the following morning. To my surprise, I could not find them. They had moved from the original nest. The next day Jim and John found them a few yards farther up the hill. A male was taken June 12. He was fed on Pet Milk through a glass tube. During the night he escaped from the box, jumped against the door, and fractured his skull. A study skin was made of this specimen and is now in the University of Michigan, Museum of Zoology. Dr. W. H. Burt sent us the following description of this specimen: "Upperparts and band across throat generally brownish slate at base of hair, tipped with buff; nose, buff to base; eye ring, pale buff; tops of front feet, pale buff; hind feet, mixed white and buff above, buff below; belly, under (inner) sides of front and hind legs, pure white; ears, like head and body; tips of ears black; tail, apparently white, might be dark at base above." The pupil in the living specimen was dark brown, the iris dark blue. Total length, 176 mm; tail, 20 mm; hind-foot, 45 mm; ear, 24 mm; weight, 104.8 grams. All seven young were similar in coloration and size.

On June 13, Jim captured another young one. This time he took over complete supervision of its care. When taken it weighed 140 grams; on June 18, 193.6 grams. The hind foot measured 51 mm. The animal was fond of Pet Milk, and also ate the leaves from alder and dwarf birch as well as the sporangia from the mosses which we placed in the box. It had a habit, when hungry, of hitting the box, using the front feet alternately thumping in rapid beats on the side of the box. For this reason we named the animal "Thumper."

Leaving Johnson River, we flew "Thumper" across the tundra to Bethel, then by PAA over Alaska to Fairbanks and subsequently, on June 24, across Yukon Territory, British Columbia and Alberta by CPA, at an elevation of 10,000 ft., to Edmonton, Alberta. A two-day train trip brought us back to Battle Creek, Michigan, where the weather was much warmer. Thumper survived the trip well.

Thumper was fed with milk for several weeks, as well as small quantities of clover, grass, carrot tops, and dandelion leaves. Gradually the diet was changed to green foods with some corn, wheat and oats added. With the coming of cold weather, lettuce, carrot tops, parsley, water-cress, twigs from the forsithea and smooth sumac were added. However, the favorite was apricot twigs and as long as the leaves remained on the apricot tree they too were eaten in preference to any other green thing offered. During the first winter, apricot bark, dead leaves, apples, rolled oats, carrot tops, and dandelion greens were eaten and as spring approached, other green plants.

PLATE 1

UPPER: Form full of young Arctic hares. Photographed June 10, 1946.

LOWER: "Thumper", an Arctic hare six months old in full winter pelage. Photographed December 15, 1946.

GROWTH

Measurements of the young in the nest are given above. On June 18 when about nine days old, Thumper weighed 193.6 grams and the hind foot measured 51 mm; on August 12, 120 mm, and increasing to 170 mm by late September. At this time the animal had attained full growth, having grown but little after mid-August. When given to the W. K. Kellogg Bird Sanctuary on March 19, 1947, weight had increased to 3525 grams (almost 8 pounds). The hind feet showed considerable growth during July and early August.

COLOR CHANGES

When we arrived on the tundra area at Johnson River June 4, the Arctic hares were brown above and white below. Thumper, like the others in the nest, had a conspicuous white eye-ring and black ear-tips. These markings remain throughout life apparently. On some of the young a white center stripe in the forehead about ten millimeters in length was present.

The change to white winter pelage started in mid-September. The ears began to turn white first and by late-September were entirely white, except for the black tips, and in strong contrast to the buffy-colored head and body. Gradually the white on the underparts began to spread onto the sides and legs and then the hair on the back, sides and shoulders became white so that by the latter part of October, the animal was entirely white except for the face and ears. The face was much slower in changing, one little spot in the middle of the forehead remaining brown until late November when that, too, became white. Now except for the brown eyes and black ear tips, the Arctic hare was entirely white.

The animal remained white until early May. The first appearance of brown was on the face and ears. These quickly changed to brown followed by the front legs and shoulders.

BEHAVIOR

Although rather tame, Thumper never liked to be caught and handled. The pen we used was open on all sides. On one side we had a small three foot box in which she might go for protection from neighborhood dogs, but it was never used. The pen was covered with one-inch mesh chicken wire so that we moved it about our back yard periodically. Thumper thus could forage on the grass and clover. If food were placed on top of the three foot tall pen, the hare stood on its hind legs and reached through the wire to get it. Sometimes the animal chewed the wire as though trying to escape; at others it ran crazily about the pen, often jumping two feet into the air. When winter came this behavior was noticed quite often and when the weather became cold, the temperature reaching 0°F., the animal often ran back and forth around the pen. More often it sat humped like a white ball in one corner of the pen, eyes half closed and ears lying back, not moving for hours. When we approached it stretched up on its hind feet and came for food or ran to the opposite side of the pen.

When a cat came into the yard the hare paid no attention. I found a cat beside the pen about mid-night one night but cats never caused any damage.

If a dog appeared, however, the hare lost all sense of direction and reasoning. It ran against the wire sides of the pen with great force often scratching its sides badly. Fearing that we might miss seeing a dog sometime, on March 19, 1947, we gave the animal to Dr. Miles D. Pirnie at the W. K. Kellogg Bird Sanctuary.

In cold blustery days, when snow or rain was falling no attempt was made to get under cover. Rather, Thumper sat out through the storm. Realizing the type of country where the animal was born, an area of wind, rain and snow, with no protection of any kind available, I could understand why it did this. I could also understand its fear of dogs because probably wolves and foxes were the natural enemies in the region where the hare was born.

Thumper seldom drank water and never bathed, but became soaked with each rain. A habit of cleanliness was indicated by the voiding droppings in a pile in one corner. Very few could be found in any other part of the pen.

1703 Central National Tower, Battle Creek, Michigan.

A KEY TO THE RODENTIA INHABITING INDIA, CEYLON, AND BURMA

(BASED ON COLLECTIONS IN THE BRITISH MUSEUM)

By J. R. ELLERMAN

Part II

258.(223). Cheekteeth not complexly prismatic in pattern (if they tend to be prismatic, they have few folds each side, and not a large number); rooted in Indian genera (and with the exception of one genus of Gerbillinae are always rooted); skull lacking specializations and peculiarities described above for Microtinae . . . . (259)

259.(282). Skull somewhat specialized, with tendency to great inflation of auditory bullae, enlargement of braincase, and weakening of zygoma, rostrum and lower jaw, its general type suggestive of that found elsewhere in saltatorial rodents; external form more or less specialized for life in deserts or plains; some species saltatorial; tail usually hairy and long in Asiatic genera; upper cheekteeth primitively biserially cuspidate, progressively becoming more or less flat-crowned and simple prismatic in type; upper incisors usually grooved.

SUBFAMILY GERBILLINAE

260.(269). Upper molars strictly simple prismatic in type at all stages of wear, and with no signs of cusps; folds of upper molars mostly equal in size (or if not, then inner fold tends to be slightly longer than outer fold); laminae of molars always joined, and folds nearly meet in middle line of tooth. (In Indian species, occipitonasal length exceeds 31 mm, and tail never dark above and below and pale along the sides) . . . . (261)

Genus MERIONES Illiger, 1811

The typical subgenus, with relatively small bullae and hairy soles does not occur in India. It is nearest subgenus *Cheliones* but its ear is not reduced.

261.(262). Ear reduced, less than one-tenth of head and body length; foreclaws enlarged;

skull somewhat bowed down anteriorly; soles partly hairy; bullae small, less than one third of occipitonasal length.

Subgenus CHELIONES Thomas, 1919

There is one species in this subgenus.

Species 57. MERIONES HURRIANAE Jerdon, 1867.

130. *Meriones hurrianae hurrianae* Jerdon, 1867. Synonym, apparently, "*collinus*" Thomas, 1919. At least 77 specimens, including types of both names just listed, examined from Chambar, Dasht, Nal and Wadh in Baluchistan; Kohat, N. W. Frontier; Hariana, Punjab; Chalchra (Thar and Parkar), Gambat, Habb Valley, Kotri, Mirpur (Sukkur), Virawar and Umankot, all Sind; Bhuj, Chalwa, Chitrod, Nokania, Rhodamotha, all Cutch; Chajli and Ding in Rajputana; Danta and Palanpur, Gujerat; Dhrangadhra, Muli, Motimijoti, and Sadla, all Kathiawar. Also a few extralimital specimens.

262.(261). Ear large, more than one-tenth of head and body length; foreclaws less prominent; skull not bowed down anteriorly . . . . (263)

263.(266). Soles of hindfeet naked; bullae small, usually less than 31% of occipitonasal length.

Subgenus PARAMERIONES Heptner, 1937

There is only one species in Indian territory.

Species 58. MERIONES PERSICUS Blanford, 1875.

264.(265). Bullae larger, 12.2 mm or more in length, and on average over 30% of occipitonasal length.

131. *Meriones persicus baptistae* Thomas, 1920. Four specimens, including the type, examined from Kelat, Kuldur, Pasht-kuh, and Turbat in Baluchistan.

265.(264). Bullae smaller, not normally exceeding 11.9 mm in length, and less than 30% of occipitonasal length.

132. *Meriones persicus persicus* Blanford, 1875. Typically from Persia. Two Indian specimens, from Kelat in Baluchistan, and some extralimital material including a co-type examined. These specimens seem to occur with *M. p. baptistae*. Only one of them has a measurable skull, and the other one might represent *baptistae*. The specimen with the skull was not collected in the same year as the Kelat specimens of *baptistae*, and there is no designation of altitude on the labels. It is always possible that in reality the two forms might occur at different altitudes. Conversely, if really large series of specimens for this rather little known species came to hand, it might prove that there is in reality only one subspecies, with the size of the bullae varying individually. But certainly in our present material *baptistae* can and should be maintained as a valid subspecies, although I cannot credit that it is a distinct species because of the apparent range clash in one locality with the typical race, as just noted.

266.(263). Soles of hindfeet hairy; bullae large, in Asiatic species averaging more than 31% of occipitonasal length . . . . (267)

Subgenus PALLASIOMYS Heptner, 1933

Two species of this subgenus reach India. Both of these occur together in many places through much of North Africa and South West Asia.

267.(268). Bullae extremely enlarged, at least 38% of occipitonasal length (in Indian subspecies).

Species 59. MERIONES CRASSUS Sundevall, 1842.

The typical race is from Sinai. The Indian race seems to differ from its relatives by its rather small size.

133. *Meriones crassus swinhoei* Scully, 1881. Typically from Afghanistan.

Two Indian specimens from Wana, in South Waziristan, and a few extralimital specimens, including the type examined.

268.(267). Bullae less extremely enlarged, about 34% of occipitonasal length.

Species 60. MERIONES LIBYCUS Lichtenstein, 1823.

The typical race is from Egypt. It must be noted that the percentages for the bullae given here refer to the Indian subspecies only. The North African subspecies of *M. libycus* have the bullae averaging smaller than the Indian race.

134. *Meriones libycus erythroura* Gray, 1842. Typically from Afghanistan. The type is in London. About three Indian specimens, from Kelat, Quetta, and Sourab in Baluchistan, and several extralimital specimens examined.

269.(260). Upper molars not strictly simple prismatic in type; at least originally there are clear signs of cusps or clear constrictions on laminae representing cusp spaces; laminae of molars not always joined, and general dental effect more complex and angular . . . . (270)

270.(277). Zygomatic plate unusually strongly thrown forwards, and angular; nasals long, usually more than 40% of occipitonasal length; bullae relatively small, not much more than a quarter of occipitonasal length, sometimes less; palate long, normally clearly over half the occipitonasal length; main outer folds of upper molars tend to be larger than inner ones; length of occipitonasal not less than 38.5 mm; tail, in Indian species, dark above and below, and pale along the sides . . . . (271)

Genus TATERA Lataste, 1882

There is only one species in Asia.

Species 61. TATERA INDICA Hardwicke, 1807.

271.(272). Length of hindfoot rarely reaches 41 mm (7 times only in 145 skins); at least in adults, hindfoot usually less than a quarter of head and body length; tail averages less than 120% of head and body length; bullae average more than a quarter of occipitonasal length.

135. *Tatera indica indica* Hardwicke, 1807. Synonyms, "*persica*" Wroughton, 1906, "*sherrini*" Wroughton, 1917, and "*dunni*" Wroughton, 1917. About 150 specimens, including the types of the four names just listed ("*persica*" is extralimital) examined from the following localities; Hazaria and Tribeni, Nepal Terai; Dela, Mussoorie, Pilibhit (Rohilkund), and Ramnagar, Kumaon; Ara, Chakri, Dhalwal, Gandhala, Kallar-kahar, Madhopur, Mogri, Rohtas, Sakesar (all Salt Range), Bhattu Hissar, Campbellpore (Chakdulla and Jhalar), Dhamtal, Handisera (near Ambala), and Jhalki, Punjab; Dagja, Khojdar, Las Bela, Mand, Nag, Pangjur, and Turbat in Baluchistan; Gulamjo-goth, Jacobabad, Kotri, Pano Aqil, Shikarpur, Sukkur, and Thar and Parkar, all in Sind; Chorepura, Gwalior; Deesa, Danta, Palanpur, all Gujerat; Junagadh, Keshod, Motimojiti, Rajkot, Talala, Vankaneer, all in Kathiawar; Mandra, Cutch; Daltongunj, Midnipur and Salbani, Bihar; Asirgarh and Sival, Nimar; Dhain and Rorighat, Hoshangabad; Chanda, and Mundra (Sangor), Central Provinces; Edlabad and Pachora, Khandesh; Poona; Ahmednaggar.

272.(271). Length of hindfoot rarely as low as 41 mm (only 7 times in 52 skins); bullae small, averaging less than a quarter of occipitonasal length . . . . (273)

273.(274). Hindfoot usually less than a quarter of head and body length; tail averages less than 120% of head and body length.

136. *Tatera indica hardwickei* Gray, 1843. Approximately 24 specimens, including the type, examined from Kolaba district; Malwan and Sukalwadi, Konkan; Ratnagiri; Ghatmatha and Helwak, Satara; Dharwar, and Hawbshavi, Dharwar district; Mahratta; Kardibetta Forest, Mysore; Gersoppa, Kanara; Virajpet, Coorg.

274.(273). Hindfoot usually more than a quarter of head and body length; tail averages 120% or more of head and body length . . . . (275)

275.(276). Length of tail approximates 120% of head and body length; occipitonasal length usually exceeds 45 mm.

137. *Tatera indica ceylonica* Wroughton, 1906. About 17 specimens, including the type, examined from Anasigalla, Colombo, Hambantota, Kwantidiya, Maha-oya, Mankeni, Welligatta and Wellawaya, all in Ceylon.

276.(275). Length of tail usually exceeds 130% of head and body length; occipitonasal length rarely reaches 45 mm.

138. *Tatera indica cuvieri* Waterhouse, 1838. About 16 specimens, the type included, examined from Vijayanagar, Bellary; Kadapa, Madras; Balapalli Range, Cuddapah; Arcot, Madras; Chettiri Range and Kurumbapatti, Salem district; Shevaroy Hills; Trinchinopoly; Kolar and Seringapatam, Mysore; Masingudi in Nilgiri Hills.

277.(270). Zygomatic plate less exaggerated; nasals, in Indian species, not reaching 40% of occipitonasal length; bullae proportionately larger; palate, in Indian specimens, less than half the occipitonasal length; main inner folds of upper molars larger than outer ones; length of occipitonasal, in the Palaearctic region, not exceeding 37 mm (in India not reaching 31 mm); tail not colored as described above for Indian species of *Tatera*.

Genus GERBILLUS Desmarest, 1804

278.(281). Soles of hindfeet entirely naked.

Subgenus DIPODILLUS Lataste, 1881

279.(280). Bullae larger, approximating 30% of occipitonasal length (in Indian specimens, their length is 8.1 mm or more).

Species 62. GERBILLUS NANUS Blanford, 1875.

Only the typical race occurs in Indian territory.

139. *Gerbillus nanus nanus* Blanford, 1875. Three Indian specimens examined from Dander, Kuldar, and Pasri in Baluchistan; also, a few extralimital specimens.

280.(279). Bullae smaller, normally less than 30% of occipitonasal length (in Indian specimens, their length is 7.9 mm or less).

Species 63. GERBILLUS DASYURUS Wagner, 1842.

The typical race is from Sinai. This species occurs with *G. nanus* in many places in South West Asia and North Africa. One race of *dasyurus* occurs in India. It averages smaller in size than typical *dasyurus*, but is not so easily separated from some other races, from Egypt and elsewhere, which antedate it.

140. *Gerbillus dasyurus indus* Thomas, 1920. Sixteen specimens, including the type, examined from Kasi Bridge, South Waziristan; Chakri (Salt Range), Punjab; Gambat (Khairpur), Indus River, Laki Hill, Pano Aqil, Ranikot, Sanu, Sehwan, Tirth Laki, all Sind; Lunwa, Palanpur; Muli, Kathiawar.

281.(278). Soles of hindfeet at least partly hairy.

Subgenus GERBILLUS Desmarest, 1804

One species of the typical subgenus occurs in India. Hitherto it was very little known, but a good series recently collected for me by Mr. W. J. C. Frost indicates that it may be retained as a valid species. It is nearest the North African *G. gerbillus*, the genotype, but it has an extremely elongated tail which usually exceeds 160% of the head and body length, thereby differing from *G. gerbillus* and its immediate allies.

Species 64. GERBILLUS GLEADOWI Murray, 1886.

141. *Gerbillus gleadowi gleadowi* Murray, 1886. Twenty-nine specimens, in-

cluding the type, examined from Chakri (Salt Range), Punjab; Gulamjo-goth, Hara (Thar and Parkar), Rohri, Umankot, all in Sind; Lunwa, (Palanpur) in Gujerat.

282.(259). Skull without modifications and specializations described above for the Gerbillinae . . . . (283)

283.(292). Upper cheekteeth in Indian genera laminate or cuspidate, the laminae separated by fairly wide folds on each side; two well marked rows of cusps present (perhaps owing to suppression of middle row of the triserially-cuspidate Murinae). In Asiatic genera, tail rather well haired.

SUBFAMILY CRICETINAE

284.(287). Tail long, normally longer than head and body; hindfoot long, not much less than a quarter and well over one-fifth of head and body length; ear long, more than one-fifth of head and body length; M^1 has five cusps; no pits between main cusps of upper molars; M^3 ringshaped . . . . (285)

Genus CALOMYSCUS Thomas, 1905

There is one species.

Species 65. CALOMYSCUS BAILWARDI Thomas, 1905.

285.(286). Occipitonasal length in our material 24.7 mm or more.

142. *Calomyscus bailwardi bailwardi* Thomas, 1905. Synonym, *"baluchi"* Thomas, 1920. Five Indian specimens, including the type of *"baluchi"*, examined from Harboi and Kelat in Baluchistan; also extralimital material, including the type of *bailwardi* from Persia.

286.(285). Occipitonasal length in our material 24.2 mm and less.

143. *Calomyscus bailwardi hotsoni* Thomas, 1920. Two specimens, the type included, examined from Gwambuk-kaul (about 30 mi. SW Pangjur) in Baluchistan. This form is not well known. Perhaps with more representative material it will prove to be a synonym of the typical race.

287.(284). Tail short, less than half head and body length in Indian species; hindfoot short, less than one-fifth of head and body length; ear short, usually less than one-fifth of head and body length; M^1 has six cusps originally (at some time during animal's life a deep pit forms between each pair of main cusps on upper molars); M^3 less reduced, and not ringshaped . . . . (288)

Genus CRICETULUS Milne-Edwards, 1867

288.(289). Bullae small, flat, about 14% of occipitonasal length or less (length in Indian skulls less than 4 mm).

Species 66. CRICETULUS ALTICOLA Thomas, 1917.

144. *Cricetulus alticola alticola* Thomas, 1917. Synonym, *"tibetanus"* Thomas and Hinton, 1922. Six Indian specimens, including the type, examined from Teza, Upper Sutlej; Durgu Village, Khardong, and Shushul, all in Ladak; also some extralimital material, including the type of *"tibetanus"*.

289.(288). Bullae large, well inflated, usually exceeding 17% of occipitonasal length (length in Indian skulls at least 5 mm).

Species 67. CRICETULUS MIGRATORIUS Pallas, 1773.

Typically from southern Russia. This species is widely distributed in Palaearctic Asia. Two definable subspecies, following the classification of Oldfield Thomas, reach Indian territory . . . . (290)

290.(291). Upper toothrow 4.4 mm or more in length, and proportionately longer.

145. *Cricetulus migratorius fulvus* Blanford, 1875. Typically from Chinese Turkestan. One Indian specimen examined from Gilgit in Kashmir, and some extralimital material.

291.(290). Upper toothrow 4.1 mm or less in length, and proportionately shorter.

146. *Cricetulus migratorius migratorius* Pallas, 1773. Three Indian specimens examined from Kelat in Baluchistan (skin only); Ladha in South Waziristan; also a large number of extralimital specimens.

292.(283). Upper cheekteeth laminate with laminae pressed closely together and not separated by widish folds each side; when cuspidate, as in the majority of genera, there are three well marked rows of cusps; external form usually generalized, tail is long and naked . . . . (293)

SUBFAMILY MURINAE

293.(312). Hallux clawless and apparently fully opposable . . . . (294)

294.(295). First and second upper molars lack posterointernal cusp.

Genus CHIROMYSCUS Thomas, 1925

Species 68. CHIROMYSCUS CHIROPUS Thomas, 1891.

147. *Chiromyscus chiropus chiropus* Thomas, 1891. This species was described from the Karin Hills in Burma. I have seen no Indian material, but I have examined extralimital specimens from Indochina.

295.(294). First and second upper molars have distinct posterointernal cusp, which is retained until dental pattern wears out . . . . (296)

296.(297). First and second lower molars with three rows of approximately equal-sized cusps; occipitonasal length, in the Indian race, exceeds 37 mm; toothrow, proportionately longer, exceeds 7 mm in length; bullae, proportionately larger, 7.7 mm or more in length.

Genus HAPALOMYS Blyth, 1859

Species 69. HAPALOMYS LONGICAUDATUS Blyth, 1859.

148. *Hapalomys longicaudatus longicaudatus* Blyth, 1859. Two Indian specimens examined from Bankason and Mita (Tavoy) in Tenasserim.

297.(296). First and second lower molars normal, with two functional rows of cusps; occipitonasal length in Indian forms not reaching 30 mm; toothrow, proportionately shorter, in Indian races less than 4 mm in length; bullae, proportionately smaller, less than 4.5 mm in length . . . . (298)

298.(299). Least interorbital breadth exceeds 4 mm (usually more than 18% of occipitonasal length); fifth finger and toe clawed.

Genus CHIROPODOMYS Peters, 1868

Only one species occurs on the mainland of Asia.

Species 70. CHIROPODOMYS GLIROIDES Blyth, 1855.

149. *Chiropodomys gliroides gliroides* Blyth, 1855. In my opinion "*peguensis*" Blyth, 1859, is a synonym. About 18 Indian specimens examined from Khonshnong in Jaintia Hills, Assam; Nam Tamai, Upper Burma; Bankason in Tenasserim; also some extralimital material.

299.(298). Least interorbital breadth less than 4 mm (usually about 15% or less of occipitonasal length); fifth finger and toe lack the claw.

Genus VANDELEURIA Gray, 1842

There is only one valid species according to the classification offered here. This genus is usually mentioned in literature as having grooved incisors, but in our very considerable material it may be seen that the incisors are certainly not normally grooved, although they may be faintly so in individual specimens.

Species 71. VANDELEURIA OLERACEA Bennett, 1832.

In the material examined, seven subspecies can be retained in India, but at least three of them are doubtful because they are so poorly known.

300.(305.) Tail long, usually exceeding 150% of head and body length . . . . (301)

301.(304). Color of back usually brighter and more red . . . . (302)

302.(303). Occipitonasal length not reaching 23 mm (in more than 30 skulls).

150. *Vandeleuria oleracea dumeticola* Hodgson, 1845. Synonym, *"marica"* Thomas, 1915. About 48 specimens, including types of both names just listed, examined from north of Toungoo and Mount Poppa in southern Burma; Nmai Valley, 27°N. in north Burma; 40–65 mi. W Kindat, west Burma; Booribazar and Bishampur, Manipur; Naga Hills, Khonshnong and Shangpung in Jaintia Hills, Assam; Angarakhata, Kamrup; Bharnabhari and Hasimara, Bhutan Duars; Pashok, Sikkim; Katmandu, Nepal; Koira (Chaibassa), Orissa.

303.(302). Occipitonasal length of type and only known specimen exceeds 23 mm.

151. *Vandeleuria oleracea rubida* Thomas, 1914. The type, from Bageswar, 3200 ft., in Kumaon examined. Perhaps this is merely an unusually large specimen of *dumeticola*. I restrict this name to the type locality. It had been reported from Ceylon but, apart from the large distance between the two localities, the Ceylon specimens have much shorter tails than *rubida*, and are here referred to *V. o. nilagirica*.

304.(301). Color of back paler, brown.

152. *Vandeleuria oleracea modesta* Thomas, 1914. Five specimens, the type included, examined from Ramnagar, 1100 ft., Kumaon. This form is distinguishable from *dumeticola* in color, but not in size.

305.(300). Tail moderate in length, in the majority of specimens less than 150% of head and body length . . . . (306)

306.(307). Back unusually dark; underparts bluish gray; occipitonasal length 24 mm and more.

153. *Vandeleuria oleracea nolthenii* Phillips, 1929. Three specimens, including the type, examined from West Haputale (Ohiya), Ceylon.

307.(306). Back less dark; underparts white; occipitonasal length not reaching 24 mm in our material . . . . (308)

308.(309). Usually smaller animals; occipitonasal length rarely reaching 22 mm (1 of 14 measurable skulls).

154. *Vandeleuria oleracea oleracea* Bennett, 1832. Synonym, *"wroughtoni"* Ryley, 1914. About 20 specimens, including the types of both names just listed, examined from Fategarh, U.P. Sehore, Central India; Agarmalwa, Khatkia and Rothiai, all Gwalior; Junagadh, Kathiawar; Hazaribagh, Bihar; Chandgarh, Nimar; Sonawahnee, Balaghat; Sheura Dangs; Dadhivara and Patal, Surat district; Ahmednaggar; Poona; Dharwar; Moz (locality not traced).

309.(308). Usually larger animals; occipitonasal length exceeds 22 mm . . . . (310)

310.(311). Color unusually pale.

155. *Vandeleuria oleracea spadicea* Ryley, 1914. Two specimens, including the type, examined from Lunwa (Palanpur), Gujerat; a little known form.

311.(310). Color not unusually pale.

156. *Vandeleuria oleracea nilagirica* Jerdon, 1867. Eleven specimens examined from Kolaba district, Konkan; Kodura, Balapalli Range, Cuddapah; Shevaroy Hill, Eastern Ghats; South Mahratta; Kutta, Coorg; Coonoor, Nilgiri Hills; Mousekande, Ceylon (the specimens hitherto erroneously referred to *rubida*).

312.(293). Hallux clawed and not fully opposable . . . . (313)

313.(326). Upper incisors clearly and prominently grooved; molars exceptionally heavily cuspidate, the center and inner rows of cusps much elevated and thickened; M^3 large, with no outer row of cusps; no posterointernal cusp in M^1 and M^3.

Genus GOLUNDA Gray, 1837

Species 72. GOLUNDA ELLIOTI Gray, 1837.

Wroughton in 1920 recognized only three forms of this genus, all of them long-standing names, but Thomas in 1923 divided the species into about eleven nominal races. All the named forms of this species are very similar to each other, and it becomes largely a matter of personal preference whether it is worth while dividing this species into subspecies at all. I offer a provisional key to seven of the named forms. I have no measurable skulls for *nuwara* and *paupera*.

314.(319). Ear usually longer, exceeding 14% of head and body length . . . . (315)

315.(316). Length of tail well over 90% of head and body length in our specimens, and may exceed head and body length; back usually grayer in color.

157. *Golunda ellioti watsoni* Blanford, 1876. About half a dozen or more specimens examined from Gambat, Habb Valley, Jacobabad, Naundero, and Sukkur, all Sind. It is possible that the form *G. e. limitaris* Thomas, 1923, from Kohat, North West Frontier, known only by the type in the British Museum, is a synonym. The skull is smashed, and it seems impossible to define the status for this supposed form until more material comes to hand.

316.(315). Length of tail more often less than 90% of head and body length; back usually less gray in color . . . . (317)

317.(318). Color generally less dark.

158. *Golunda ellioti myothrix* Hodgson, 1845. About 23 specimens, including the type, examined from Nepal; Bageswar, Dela (Ramnagar) and Sitabani, Kumaon; Dhalwal, Sakesar (Salt Range), Dhamtal, Dharmsala, Gopalpur, Kangra Fort, and Siluni (Chanba district), all Punjab.

318.(317). Color generally darker.

159. *Golunda ellioti coenosa* Thomas, 1923. About 11 specimens, including the type, examined from Angarakhata, Kamrup, also Bharnabhari and Hasimara in Bhutan Duars (last named the type locality).

319.(314). Ear usually shorter, less than 14% of head and body length . . . . (320)

320.(321). Length of hindfoot 22 mm and less (but very few skins available).

160. *Golunda ellioti paupera* Thomas, 1923. Three specimens, including the type, examined from Handisera (near Ambala), Punjab.

321.(320). Length of hindfoot rarely as low as 22 mm . . . . (322)

322.(323). Color of back markedly darker.

161. *Golunda ellioti nuwara* Kelaart, 1850. Four specimens examined from Ambawela, Pattipola and West Haputale, Ceylon.

323.(322). Color of back less dark . . . . (324)

324.(325). Color averages slightly paler, more noticeably so below.

162. *Golunda ellioti gujerati* Thomas, 1923. About 13 specimens, the type included, examined from Charwar, Cutch; Mount Abu, Rajputana; Danta and Lunwa (Palanpur), Gujerat; Dhrangadhra and Motimojiti, Kathiawar.

325.(324). Color averages less pale.

163. *Golunda ellioti ellioti* Gray, 1837. Synonyms, "*bombax*" Thomas, 1923, "*coraginis*" Thomas, 1923, and possibly "*coffaeus*" Kelaart, 1850. About 41 specimens, including the types of the four names just listed, examined from Binaganj and Morar, Gwalior; Paresnath, Hazaribagh; Mundra, Sangor; Chikalda, Berar; Asirgarh, Nimar; Sakot, Hoshangabad; Sonawahnee, Balaghat; Chanda, C.P.; Ghodesgaon and Shernduri, Khandesh; Poona, and south of it; Andheri, Salsette Island; Helwak, Satara; Ratnagiri, Konkan; Dharwar and Hawbshavi, Dharwar district; Kardibetta Forest, Mysore; Virajpet and Wotekolli, Coorg; Chettiri Range and Kurumbapatti, Salem district, Eastern Ghats; Cumbum, Madura; Peradeniya, Ceylon.

There are individual exceptions to almost all the characters given in the

provisional key above; *gujerati* is the most doubtful of the races here retained; *nuwara* is I think valid and should stand.

326.(313). Upper incisors normally not grooved; molars never as described above for *Golunda*, and much less abnormal . . . . (327)

327.(348). Incisors pro-odont, so that the condylobasal length is normally about equal to occipitonasal length (in *Diomys*) or normally exceeds it (always so in *Nesokia* and *Bandicota bengalensis*; in *Bandicota indica* there are about 11 exceptions out of 62 skulls) . . . . (328)

328.(347). Occipitonasal length not less than 34.6 mm; length of palate averages at least 58% of occipitonasal length; lower incisor root forms a prominent knob on outer side of lower jaw; palatal foramina proportionately shorter; molars tend to become plain straight laminate; bullae enlarged, averaging between 15% and 22% of occipitonasal length . . . . (329)

329.(344). Palatal foramina not reduced, normally exceeding 7 mm in length, and most often exceeding 18% of occipitonasal length; M^3 usually retains some traces of original front lamina; length of tail usually exceeds three quarters of head and body length.

Genus BANDICOTA Gray, 1873

330.(335). Bullae smaller, usually less than one-fifth of occipitonasal length; nasals more than one-third of occipitonasal length, as a rule; length of palate usually less than 60% of occipitonasal length; occipitonasal length varies between 46 mm and 68 mm; braincase as a rule proportionately narrower.

Species 73. BANDICOTA INDICA Bechstein, 1800.

331.(332). Small race; occipitonasal length only once reaches 50 mm.

164. *Bandicota indica savilei* Thomas, 1916. Seven specimens, including the type, examined from Pagan and Mount Poppa in Burma.

332.(331). Larger races; in adult, occipitonasal length only once under 50 mm in more than 40 specimens . . . . (333)

333.(334). Length of nasals 20.8 mm at highest, but most often less than 20 mm; medium sized race, occipitonasal length varying between 50 and 57 mm.

165. *Bandicota indica nemorivaga* Hodgson, 1836. Synonyms, *"elliotana"* Anderson, 1878, and *"macropus"* Hodgson, 1845. About 15 specimens, including the type, and type of *"macropus"*, examined from 12–30 mi. SE Pegu, and Toungoo, Burma; Khasi Hills in Assam; Angarakhata, Kamrup; Hasimara, Bhutan Duars; Calcutta; Katmandu and Nan Glepany, (Gorkha), Nepal; also extralimital material.

334.(333). Length of nasals approximates or exceeds 21 mm; a medium sized or large race, occipitonasal length varies between 52 and 68 mm in our material.

166. *Bandicota indica indica* Bechstein, 1800. Synonyms, *"malabarica"* Shaw, 1801, *"gigantea"* Hardwicke, 1804, *"bandicota"* Bechstein, 1800. More than 40 specimens, including type of *"gigantea"*, examined from Hardwar and Delhi, United Provinces; Sambhar, Rajputana; Danta, Gujerat; Sasan (Junagadh), Kathiawar; Chilka Lake, Orissa; Bahri and Gajhundi, Hazaribagh; Sonawahnee, Balaghat; Chichpalli, Chanda; Andheri, Salsette Island; Ghatmatha, Satara district; Devikop, South Mahratta; Dharwar and Samasgi, Dharwar district; Nellore, Madras; Madras, no exact locality; Kodura (Balapalli Range), and Palkonda Hills, Cuddapah; Bangalore, Kolar and Sagar, Mysore; Virajpet, Coorg; Coonoor and Ootacamund, Nilgiri Hills; Payangadi, Malabar; Anasigalla, Ambawela, Horton Plains, Pundulbya, and Udugama in Ceylon.

It is likely that there is really only one subspecies in western India, as indicated above. Wroughton restricted *B. i. indica* to two skulls from Coonoor and Ootacamund (and a skin from Nellore, Madras); in these specimens the

occipitonasal length is not more than 55.5 mm. The remainder he referred to *"malabarica"* or *"gigantea"*, the supposed giant races, in which the occipitonasal length is in about 30 skulls not less than 56.2 mm. There is, therefore, a line which could be drawn between a supposed form with a slightly smaller skull inhabiting the Nilgiri Hills region, and a form with a slightly or considerably larger skull which would range intermittently from Ceylon north to Delhi and Hardwar. But the difference between the smallest *"malabarica"* skull and the largest of the Nilgiri specimens is much smaller than that between the smallest and largest specimens of *"malabarica"*, which varies in our material between 56.2 mm and 68.7 mm. I am inclined to doubt whether the typical *B. indica* of Wroughton is based on anything but two small individuals, and I feel fairly certain that if enough specimens came to hand from the Nilgiri Hills region the supposed size differences between the two named forms would cease to exist.

335.(330). Bullae larger, normally exceeding one-fifth of occipitonasal length; nasals as a rule less than one-third of occipitonasal length; length of palate normally more than 60% of occipitonasal length; occipitonasal length varies between 35 and 49 mm; braincase usually proportionately wider . . . . (336)

Species 74. BANDICOTA BENGALENSIS Gray and Hardwicke, 1833.

We have more than 100 examples of this species in the British Museum, and it is extremely difficult to divide it into subspecies in a satisfactory manner. Owing to the paucity of material I am quite unable to include the form *B. b. insularis* Phillips, 1936, for which I have seen two specimens, the type included, from Thinney, near Jaffna, North Ceylon, in my key. Of the remainder, *B. b. varius* is valid, but the other forms are much like each other. The characters that I give for *B. b. gracilis* are very provisional. Our material for this form is poor, and the characters of the London material do not seem to be borne out by Phillips' notes in his book on the mammals of Ceylon.

336.(337). Occipitonasal length exceeds 44 mm.

167. *Bandicota bengalensis varius* Thomas, 1907. Typically from Penang. Nine Indian specimens examined from Mergui, Tenasserim, 12 mi. SE Pegu, Prome and Toungoo in Burma. The type is in the British Museum.

337.(336). Occipitonasal length very rarely reaches 44 mm (about five individuals in a hundred) . . . . (338)

338.(341). Upper toothrow as a rule relatively longer, most often 7 mm or more in length (about 14 exceptions in 64 skulls) . . . . (339)

339.(340). Fur thick and soft.

168. *Bandicota bengalensis wardi* Wroughton, 1908. Nine specimens, the type included, examined from Chakothi, Manashal Wooler Lake, Pandritton, Srinagar and Thelum Banku, in Kashmir; Siul Lake, and Siluni, (Chamba), Punjab.

340.(339). Fur usually shorter and harsher.

169. *Bandicota bengalensis kok* Gray, 1837. Synonyms, *"lordi"* Wroughton, 1908, and *"sindicus"* Wroughton, 1908. About 65 specimens, including types of the three names just listed, examined from Dagshai (Simla Hills), Punjab; Pithoro and Umankot, Sind; Rajkot and Talala (Junagadh), Kathiawar; Asirgarh, Chandgarh, Ganoor and Sival, Nimar; Dhain, Hoshangabad; Ghodesgaon and Parola, Khandesh; Surat district; Ahmednaggar; Madha, Satara district; Poona; Kolaba district; Konkan; Khed and Shirgaon, Ratnagiri; Vijayanagar, Bellary; Devikop, Gadag and Hawbshavi, Dharwar district; Kanara; Balapalli Range, Cuddapah; Madras; Kolar, Mysore; Srimangala and Wotekolli, Coorg; Coonoor, Kotagiri and Ootacamund, Nilgiri Hills; Kukhal and Trivandrum, Travancore.

341.(338). Upper toothrow as a rule relatively shorter, most often less than 7 mm (about 17 exceptions in 44 skulls, all in the typical race) . . . . (342)

342.(343). Tail in our specimens less than 80% of head and body length.

170. *Bandicota bengalensis gracilis* Nehring, 1902. Synonym, *"dubius"* Kelaart, 1850, preoccupied. About five specimens, including a type of *"dubius"*, examined from Daltota, Kandy, and Tammanewa in Ceylon. The race *B. b. insularis* seems to be most like this form, agreeing with it in the relatively short toothrow.

343.(342). Tail averages more than 80% of head and body length.

171. *Bandicota bengalensis bengalensis* Gray and Hardwicke, 1833. Synonyms apparently include *"daccaensis"* Tytler, 1854, *"tarayensis"* Horsfield, 1855, *"plurimammis"* Horsfield, 1855, and *"morungensis"* Horsfield, 1855. About 65 specimens, including types of the five names just listed, examined from Tatkon, West Burma; Gologhat in Naga Hills, Assam; Angarakhata, Kamrup; Hasimara, Bhutan Duars; Ghoom, Kalimpong, Narbong, Nimbong, Pashok, all Sikkim or Darjiling district; Bairia, Gorkha and Hazaria, Nepal; Bageswar and Takula, Kumaon; Calcutta; Luia and Sangajota, (Chaibassa), Orissa; Midnipur and Salbani, Bengal; Dantongunj, Bihar; Morar and Rothiai, Gwalior; Guna, Central India.

It is a curious fact that in southern Burma, the largest race of *Bandicota bengalensis* (*varius*) occurs near the smallest race of *Bandicota indica* (*savilei*). These two forms are most easily distinguished from each other by the proportionate length of the palate. As usual, the palate is proportionately longer in *B. b. varius*; proportionately shorter in *B. i. savilei*. Large specimens of *B. b. varius* are sometimes larger than small specimens of *B. i. savilei* in size of skull.

344.(329). Palatal foramina strongly shortened, not reaching 7 mm in length, and averaging 14% or less of occipitonasal length; M^2 lacks traces of original front lamina; tail usually less than three-quarters of head and body length.

Genus NESOKIA Gray, 1842

Species 75. NESOKIA INDICA Gray and Hardwicke, 1832.

345.(346). Dorsal coloration darker.

172. *Nesokia indica indica* Gray and Hardwicke, 1832. Synonyms, *"griffithi"* Horsfield, 1851, and *"baeba"* Wroughton, 1908. Twenty or more specimens, including the types of all names just listed, examined from Khojdar and Quetta in Baluchistan; Ladha, South Waziristan; Kohat and Pushut, North West Frontier; Abdul Hassan, Gandhala and Kallar-Kahar (the last two in the Salt Range), Kurram Valley and Rawalpindi in Punjab; Chak (Sukkur), Jacobabad, Pano Aqil, Pithoro, Tong and Umankot, all in Sind; Delhi and Fategarh, United Privinces; Jeypur and Sambhar, Rajputana; Jerna (Ramnagar), Kumaon.

346.(345). Dorsal coloration paler, more sandy or varying to light reddish.

173. *Nesokia indica huttoni* Blyth, 1846. Typically from Afghanistan. The type is in the British Museum. Seven Indian specimens examined from Fittak (Pasht-i-kuh), Kalegar and Pangjur in Baluchistan.

347.(328). Occipitonasal length not exceeding 33.2 mm; length of palate proportionately shorter, approximating 55% or 56% of occipitonasal length; lower incisor root forms only a weak knob on outer side of lower jaw; palatal foramina extremely lengthened, usually about 23% of occipitonasal length; molars not tending to become plain straight laminate; bullae roughly 19% of occipitonasal length.

Genus DIOMYS Thomas, 1917

Species 76. DIOMYS CRUMPI Thomas, 1917.

174. *Diomys crumpi crumpi* Thomas, 1917. This genus was originally described from Paresnath, Bihar, and was based on a broken skull without a skin. It has now been rediscovered, nearly 30 years after it was first described, in

considerable numbers in Manipur. The external characters present a superficial resemblance to those of *Hadromys humei*, including the shortened fifth finger and shortened hallux and fifth toe. The tail is usually slightly longer than the head and body, and is sharply bicolor; fur soft; color blackish gray above, feet white, underparts whitish gray. I have measured 21 skulls and in all but three the condylobasal length exceeds or equals the occipitonasal length. About 31 specimens, including the type, examined from Bishampur, Manipur; Paresnath, (Hazaribagh), Bihar (the type locality).

348.(327). Incisors less pro-odont; condylobasal length shorter than occipitonasal length; lower incisor root forms a much less prominent knob on outer side of lower jaw than in *Nesokia* and *Bandicota*, when visible, and molars usually more cuspidate than in these genera. Those below never combine the characters of *Diomys*, *Bandicota* or *Nesokia* . . . . (369)

349.(350). Mesopterygoid fossae roofed in by bone anteriorly; fur densely spiny; no posterointernal cusp in M^1 and M^2.

Genus ACOMYS Geoffroy, 1838

One specimen of this genus has been taken in Indian territory. The first named Palaearctic species for this genus is *A. cahirinus*, and I refer the Indian form to this species.

Species 77. ACOMYS CAHIRINUS Desmarest, 1819.

Typically from Egypt.

175. *Acomys cahirinus flavidus* Thomas, 1917. The Indian form was separated under this name by Thomas. It is nearest *A. c. dimidiatus* Cretzchmar, 1826, from Sinai, and until more specimens come to hand it seems very difficult to define characters to prove that the Indian form is valid, when compared with several southwestern Asiatic subspecific names in the species which antedate it. The type from Laki Hills (Sehwan), in Sind, has been examined.

350.(349). Mesopterygoid fossae not roofed in by bone anteriorly . . . . (351)

351.(364). Well developed posterointernal cusp present in first and second upper molars, and is retained until whole dental pattern wears out . . . . (352)

352.(353). Pygmy species, the occipitonasal length not exceeding 19.5 mm (in London material); rostrum shortened, diastema approximating 20% or 21% of occipitonasal length; as far as known, tail prehensile.

Genus MICROMYS Dehne, 1841

Species 78. MICROMYS MINUTUS Pallas, 1769.

Typically from Russia. The Indian subspecies differs from the western European races in having the tail averaging longer than head and body. Unfortunately we do not have the typical race in the British Museum.

176. *Micromys minutus erythrotis* Blyth, 1855. Synonym, *"pygmaeus"* Milne-Edwards, 1874. I have seen only one Indian specimen, from the Naga Hills in Assam. This race was originally described from Assam. We have some extralimital specimens from China and Indochina.

353.(352). Occipitonasal length at least 22 mm; rostrum less shortened, diastema proportionately longer; tail not prehensile.

Genus APODEMUS Kaup, 1829

Two enormously widely distributed groups of subspecies of this genus occur together through nearly the whole of the Palaearctic region. I propose to make these races of, respectively, the two earliest named western European species, *A. sylvaticus* and *A. flavicollis*. It is quite possible that another species, *Apodemus agrarius* Pallas, 1778, (*A. agrarius chevrieri* Milne-Edwards, 1868),

will occur in East Burma, as it is very common in West Yunnan, but I have not yet found Indian specimens in the large collection of the British Museum. The two species which occur commonly in North India differ from each other here, as elsewhere, in the average size of the skull.

354.(357). Occipitonasal length usually less than 27 mm.

Species 79. APODEMUS SYLVATICUS Linnaeus, 1758.

Typically from Sweden. There are two races in India which may be referred to this species.

355.(356). Palatal foramina normally 5 mm or less in length, less than one-fifth of occipitonasal length; tail most often shorter than the head and body.

177. *Apodemus sylvaticus pentax* Wroughton, 1908. Eleven specimens, the type included, examined from Gharial, Murree, and Thandiani in the Punjab.

356.(355). Palatal foramina most often 5.2 mm or more in length, and usually more than one-fifth of occipitonasal length; tail usually much longer than head and body.

178. *Apodemus sylvaticus orestes* Thomas, 1911. Typically from Szechuan, China. The type is in the British Museum. At least nine Indian specimens examined from Dreyi in Mishmi; Mount Imaw Bum, and Naunchaung Valley (Wulaw Pass), North Burma; also many extralimital ones.

357.(354). Occipitonasal length usually more than 27 mm.

Species 80. APODEMUS FLAVICOLLIS Melchior, 1834.

Typically from Denmark. Four Indian subspecies appear to be referable to this species.

358.(361). Palate long, usually exceeding half the occipitonasal length . . . . (359)

359.(360). Tail most often shorter than head and body, or individually only a little longer; color rather pale.

179. *Apodemus flavicollis wardi* Wroughton, 1908. About 21 specimens, the type included, examined from the following localities in Kashmir: Durgu Village, Kharchar, Leh and Saspul, all Ladak; Arthroothoo Nullah, Chichoti, Dangail (Kishtwar), Gulmerg, Gugga Nullah, Moolbeck and Moonlan; Rupal (Astor).

360.(359). Tail always much longer than head and body; color rather dark.

180. *Apodemus flavicollis gurkha* Thomas, 1924. Eight specimens, including the type, examined from Apoon Sottidanda, Barpak and Laprak, all Gorkha, Nepal.

361.(358). Palate shorter, usually less than half the occipitonasal length, or sometimes approximating half this length at highest . . . . (362)

362.(363). Ear proportionately longer, usually about 19% of head and body length.

181. *Apodemus flavicollis latronum* Thomas, 1911. Typically from Szechuan. The type is in the British Museum. About 26 Indian specimens examined from the Adung Valley in North Burma; also many extralimital specimens.

363.(362). Ear proportionately smaller, rarely as long as 19% of head and body length.

182. *Apodemus flavicollis rusiges* Miller, 1913. About 45 specimens examined from Kagan Valley, N.W. Frontier Province; Aru, Chandawara, Doosoo, Noogali, Pahlgahm, Skardu (Baltistan), Sardalla and Surez, all Kashmir; Gondla, Kyelang, Kothi and Rahla, all Lahul, and Murree, Punjab; Phurkia in Kumaon.

364.(351). No distinct posterointernal cusp in first and second upper molars . . . . (365)

365.(482). Upper toothrow not specialized by enlargement of M^1 so that it is normally over half the length of toothrow, combined with distortion inwards of the anterointernal cusp, and strong to extreme reduction of M^3 . . . . (366)

366.(367). Zygomatic plate with anterior border concave; M^3 relatively large; incisors heavy; fifth finger short, and outer digits of hindfoot shortened; bullae average about 15% of occipitonasal length; a rather small rat, the skull about the same size as that of *Rattus exulans*; tail longer than head and body; palate and palatal foramina long.

Genus HADROMYS Thomas, 1911

Species 81. HADROMYS HUMEI Thomas, 1886.

183. *Hadromys humei humei* Thomas, 1886. About 25 specimens, including the type, examined from Angarakhata, Kamrup; Bishampur and Moirang in Manipur. The last named is the type locality. Some valuable material for this genus has recently come to hand from Mr. W. J. C. Frost.

367.(366). Zygomatic plate with anterior border normally not concave . . . . (368)

368.(371). Upper toothrow very long, approximating one-fifth of occipitonasal length, or more; large rats, occipitonasal length exceeding 50 mm; bullae small, only about one-tenth of occipitonasal length, or sometimes slightly more individually; in our material length of upper toothrow exceeds 11 mm.

Genus DACNOMYS Thomas, 1916

Species 82. DACNOMYS MILLARDI Thomas, 1916.

There are two named Indian subspecies, both of which are little known.

369.(370). Occipitonasal length approximates 54 mm at highest; length of palatal foramina approximate 10.3 mm at highest; color slightly darker.

184. *Dacnomys millardi millardi* Thomas, 1916. Two specimens, including the type, examined from Gopaldhara, near Darjiling; Okotso in the Naga Hills, Assam.

370.(369). Occipitonasal length exceeds 60 mm; length of palatal foramina approximates 11.7 mm; color slightly paler.

185. *Dacnomys millardi wroughtoni* Thomas, 1922. Two specimens, including the type, examined from Dreyi in Mishmi. With more representative material it might be discovered that the latter merely represents older specimens of the former.

371.(368). Upper toothrow less than one-fifth of occipitonasal length . . . . (372)

372.(379). Combining the following characters: palatal foramina unusually lengthened, 23% of occipitonasal length or more; palate long, exceeding half the occipitonasal length; plantar pads reduced in number (less than six), so far as is known; fifth hindtoe shortened.

Genus MILLARDIA Thomas, 1911

373.(374). Small species, occipitonasal length not exceeding 27.3 mm; length of upper toothrow 4.6 mm or less; ear very large, about as long as hindfoot, and more than a fifth of head and body length; mammae 6; bullae large, usually more than a fifth of occipitonasal length.

Species 83. MILLARDIA GLEADOWI Murray, 1885.

186. *Millardia gleadowi gleadowi* Murray, 1885. About 17 specimens, the type included, examined from Kirgi Bridge, South Waziristan; Karachi, and Thar and Parkar in Sind; Lunwa, Palanpur; Dhrangadhra, Muli and Rajkot in Kathiawar. The South Waziristan specimens are smaller cranially than the others and might represent a new subspecies, but their skins are in bad condition.

374.(373). Larger species, occipitonasal length not less than 28 mm; length of upper toothrow 4.8 mm or more (very rarely less than 5 mm); ear moderate in length, shorter than hindfoot, with few exceptions, and less than a fifth of head and body length . . . . (375)

375.(376). Length of bullae usually 6.8 mm or more, often as much as one-fifth of occipitonasal length; occipitonasal length 34 mm or more (with one exception); mammae 4 (so far as known, the pectoral pairs suppressed).

Species 84. MILLARDIA KATHLEENAE Thomas, 1914.

187. *Millardia kathleenae kathleenae* Thomas, 1914. About 14 specimens including the type, examined from Pagan, Mount Poppa and Pyawbye in Burma.

376.(375). Length of bullae rarely more than 6.5 mm, and less than one-fifth of occipitonasal length, which is most often below 34 mm (about 11 exceptions in 48 skulls); mammae, so far as known, 8 in number, pectoral pairs present.
Species 85. MILLARDIA MELTADA Gray, 1837.

377.(378). Back averages paler, more pallid gray.

188. *Millardia meltada pallidior* Ryley, 1914. Synonym, *"dunni"*, Thomas, 1917. About 18 specimens, including the types of both names just listed, examined from Bhattu Hissar, Damthal (Kangra district), Handisera (Ambala), and Pathankot, Punjab; Bairia (Patheghatta) Nepal Terai; Sakhlat and Umankot, Sind; Nokania, Cutch; Deesa and Lunwa, Gujerat; Dhrangadhra, Muli, Rajkot and Satapur, Kathiawar.

378.(377). Back averages darker, more grey-brown or brownish.

189. *Millardia meltada meltada* Gray, 1837. Synonyms, *"listoni"* Wroughton, 1907, *"comberi"* Wroughton, 1907, and *"lanuginosus"* Elliot, 1839. About 40 specimens, including types of the four names just listed, examined from Agar Malwa and Binaganj, Gwalior; Guna, Central India; Paresnath (Hazaribagh), Bihar; Asirgarh and Ganoor, Nimar; Sakot, Hoshangabad; Mundra, Sangor; Chanda, Central Provinces; Nasik, Ahmednaggar, Poona, Konkan, all in Bombay State; Dharwar and Gadag, Dharwar district; Kutta, Coorg; Ootacamund, Nilgiri Hills; South Coimbatore; Madras; Chettiri Range (Salem), Eastern Ghats; Hambantota, Wellawaya and Welligatta, all in Ceylon.

379.(372). Palatal foramina less than 23% of occipitonasal length, except for two species (subgenus *Cremnomys*), in which the palate is short, less than half the occipitonasal length; plantar pads six in number; fifth hindtoe rather noticeably long.

Genus RATTUS Frisch, 1775 (or Fischer, 1803)

Rattus is the largest genus of Mammalia in number of species and named races. In my forthcoming third volume of the Families and Genera of Living Rodents, I am publishing a revision of the Asiatic, European and Australian forms of the genus. Partly for convenience I am dividing the 60 odd species into 7 subgeneric groups. All of these subgenera occur in India.

380.(391). Palatal foramina unusually long, well over one-fifth of occipitonasal length; palate less than half the occipitonasal length; bullae small or medium in size, roughly 14% or 15% of occipitonasal length; a tendency present for reduction of roots in M^1 so that there are less than five roots in this tooth, and for coronoid process of mandible to be rather low.

Subgenus CREMNOMYS Wroughton, 1912

381.(390). Occipitonasal length not exceeding 35.7 mm; palatal foramina proportionately longer.
Species 86. RATTUS CUTCHICUS Wroughton, 1912.

382.(383). Tail most often more than 130% of head and body length; rather small race; hindfoot 25 mm or less; occipitonasal length usually less than 33 mm.

190. *Rattus cutchicus cutchicus* Wroughton, 1912. About 19 specimens, the type included, examined from Chalwar, Dhonsa, Nokania, Padampur, Poiwadi and Rhodamotha in Cutch. Some skins from Kurumbapatti and Tirthemalai, Salem district, Eastern Ghats perhaps represent a new subspecies. These are similar to the typical race in their very long tails, but have a slightly larger hindfoot and a slightly larger skull.

383.(382). Tail most often less than 130% of head and body length; occipitonasal length usually more than 33 mm; hindfoot usually more than 25 mm in length . . . . (384)

384.(387). Tail rather short, usually less than 120% of head and body length . . . . (385)

385.(386). Underparts near pure white.

type included, examined from Bishampur and Hopum Thal in Manipur; 6 mi. W Kindat, 10 mi. SW Kindat, and Kabaw Valley (20 mi. W Kindat), in West Burma. Two specimens collected by Mr. W. J. C. Frost in the Naga Hills, Assam, might represent a new race of this species, but the diastema seems a little shorter than is normal. Possibly they are not entirely adult, so I refrain from naming them until more material comes to hand. They are not *R. bowersi mackenziei*, which also occurs at the same place.

404.(403). Length of bullae exceeds 7 mm; where ascertainable, roughly 19–20% of occipitonasal length (material examined not entirely representative).

Species 93. RATTUS BERDMOREI Blyth, 1851.

I have never seen the typical race, which seems to be known only by the type, and which apparently came from Mergui. Thomas has separated another specimen racially; this differs from the typical specimen in its smaller size, apparently.

202. *Rattus berdmorei mullulus* Thomas, 1916. The type from Thagata in Tenasserim, (Mount Mooleyit Range) has been examined.

405.(402). Upper incisors less pro-odont; diastema proportionately shorter, usually less than 30% of occipitonasal length . . . . (406)

406.(437). Bullae small, averaging less than 15% of occipitonasal length . . . . (407)

407.(416). Palate long, clearly over half the occipitonasal length.

Subgenus STENOMYS Thomas, 1910

This name was based on a species from New Guinea. I use it in a subgeneric sense for a widely distributed Indomalayan group of rats which also occurs in New Guinea and in which, generally speaking, the palate and palatal foramina remain long, as in the typical subgenus, but, as just indicated, the bullae are too small for that subgenus. Three species occur in India.

408.(413). Diastema usually proportionately longer, approximating 28% of occipitonasal length at lowest, 30% at highest; supraorbital ridges relatively weak.

Species 94. RATTUS BOWERSI Anderson, 1879.

409.(410). Occipitonasal length not less than 53 mm in fully adult material (only once less than 54 mm in British Museum material).

203. *Rattus bowersi bowersi* Anderson, 1879. Typically from Yunnan. About 7 Indian specimens examined from Mokokchung in Naga Hills, Assam; Machi, Manipur; Kindat, 50 mi. W Kindat, Nam Tamai and Nam Tisang Valley, Burma; also extralimital material.

410.(409). Occipitonasal length 52 mm or less (reaching 52 mm only once in British Museum material), most often less than 50 mm . . . . (411)

411.(412). Tail (according to published measurements) exceeds 260 mm in length; hindfoot (according to published measurements) 51–52 mm.

204. *Rattus bowersi feae* Thomas, 1916. The type skull from Thagata (Mooleyit Range), Tenasserim, has been examined.

412.(411). Tail length less than 260 mm; hindfoot (with 1 exception in 29 skins) not reaching 50 mm.

205. *Rattus bowersi mackenziei* Thomas, 1916. Synonym, "*wellsi*" Thomas, 1921. Twenty-nine specimens, including the types of both names just listed, examined from Khasi Hills, Assam, including Mawphlane (type locality of "*wellsi*"), Naga Hills, Assam, Haingyan (? in East Manipur), Bishampur in Manipur; 50 mi. W Kindat, and Hills east of Nam Tisang, in Burma.

413.(408). Diastema proportionately shorter, normally 27% or less of occipitonasal length; supraorbital ridges not particularly weak . . . . (414)

414.(415). Tail normally longer than head and body; occipitonasal length usually exceeds 50 mm, rarely as low as 48 mm.

Species 95. RATTUS MULLERI Jentink, 1879.

The typical race is from Sumatra. One subspecies has been taken in Indian territory.

206. *Rattus mulleri validus* Miller, 1900. One Indian specimen, from Thaget in Tenasserim, and some extralimital material were examined. This race is probably distinguishable from the typical race by some cranial details, but our material for typical *R. mulleri* is inadequate. Besides this, there is a specimen in the British Museum from the Andaman Islands which represents a species near *R. mulleri* or *R. bowersi*. Blanford, 1891, thought it was a variety of *R. bowersi*, and Miller has suggested that it may be *Rattus taciturnus* Miller, 1902, from South Andaman Island. Our skin is unmeasured, and without more representative material I cannot allocate this form. The skull differs from *R. mulleri validus* in having larger bullae, considerably narrower molars, and longer diastema. The color of the back is lighter. It seems a larger animal in skull size than the next species, *Rattus rogersi*.

415.(414). Tail apparently shorter than head and body; occipitonasal length about 48 mm. Species 96. RATTUS ROGERSI Thomas, 1907.

207. *Rattus rogersi rogersi* Thomas, 1907. The type specimen from North of Ike Bay, South Andaman Island has been examined. This form is known by only one specimen. It is very difficult to allocate it in a satisfactory manner, and it may well be a subspecies of one of the several forms named by Miller in 1902 from the Andaman or Nicobar islands. All of these are unrepresented in the London collection and not available to me for comparison. The first name for a rat from this group of islands is *Rattus palmarum* Zelebor, 1869. It appears to be a short-tailed form, and was named from the Nicobar Islands.

416.(407). Palate short, less than half the occipitonasal length; palatal foramina long, averaging 16% or more of occipitonasal length.

Subgenus MAXOMYS Sody, 1936

This name was based on a Javanese species. I use it in a wider sense, as a subgenus for those *Rattus* rats which differ from the typical subgenus in their smaller bullae and shorter palate, but which retain the long palatal foramina, thereby differing from subgenus *Apomys*.

417.(418). Length of palate exceeds 20 mm; length of upper toothrow about 6.8 mm at lowest; width of M^1 exceeds 2 mm.
Species 97. RATTUS COXINGI Swinhoe, 1864.
This is one of the earliest names in the present subgenus. This species, as here understood, occurs with representatives of both of the specific names which antedate it, and so may be given specific rank. I use it in a wide sense. The typical race is from Formosa. One form is said to occur in North Burma.

208. *Rattus coxingi andersoni* Thomas, 1911. I have seen several Chinese specimens, including the type. We have no Indian material, but Anthony has recorded it from North Burma. Softer fur and probably longer tail distinguish it from the spiny typical race from Formosa.

418.(417). Length of palate rarely reaches 20 mm; length of upper toothrow rarely reaches 6.8 mm; width of M^1 normally less than 2 mm. (Most of our specimens of *R. c. andersoni* have the toothrow exceeding 7 mm. Of those that follow, the few specimens which have the toothrow as much as 6.8 mm have the length of the palate less than 20 mm. In this subgenus, one is dealing with very large numbers of specimens) . . . . (419)

419.(422). Tail normally wholly dark in color.
Species 98. RATTUS CREMORIVENTER Miller, 1900.
Typically from Trang in Siamese Malaya.

420.(421). Large race; occipitonasal length exceeds 41 mm.

209. *Rattus cremoriventer tenaster* Thomas, 1916. Two specimens, including the type, examined from Mount Mooleyit in Tenasserim.

421.(420). Smaller race; occipitonasal length apparently less than 36 mm.

210. *Rattus cremoriventer indosinicus* Osgood, 1932. Two specimens examined from Margherita, Naga Hills, Assam and 50 mi. W Kindat, Burma. This is nearer the typical race, but it differs apparently in the fact that the interorbital breadth is narrower. *R. cremoriventer* is not a very well known species, and neither of the above races are well represented in London.

422.(419). Tail normally of two colors, usually dark above and pale below . . . . (423)

423.(430). Tail elongated, approximating 140% of head and body length, or exceeding it, in the majority of specimens . . . . (424)

424.(427). Small species; occipitonasal length less than 32 mm; length of palate less than 15 mm; underparts gray in color; supraorbital ridges proportionately weak.

Species 99. RATTUS EHA Wroughton, 1916.

425.(426). Tail length roughly 160% of head and body.

211. *Rattus eha eha* Wroughton, 1916. Seven specimens, including the type, examined from Apoon Sottidanda (Gorkha), Nepal; Ghoom, Lachen, Sukiapohkri and Thangu, all Sikkim or Darjiling district.

426.(425). Tail usually less than 150% of head and body length.

212. *Rattus eha ninus* Thomas, 1922. Typically from Yunnan. Four Indian specimens examined from Adung Valley, and Mount Imaw Bum, North Burma; also extralimital material.

427.(424). Larger species; occipitonasal length not less than 32.8 mm; length of palate exceeds 15 mm.

Species 100. RATTUS FULVESCENS Gray, 1846.

This is the second name in the present subgenus. It occurs extensively with *R. niviventer*, which is the only specific name that antedates it. As here understood, it contains most of the forms referred by Chasen in his Handlist of Malay Mammals (1940) to *Rattus rapit*, as well as those listed here.

428.(429). Length of upper toothrow 6.3–6.8 mm.

213. *Rattus fulvescens brahma* Thomas, 1914. Half a dozen specimens, the type included, examined. The type was from Anzong Valley, Mishmi. Some specimens from the Adung Valley, North Burma, are similar except perhaps for their darker underparts.

429.(428). Length of upper toothrow normally less than 6.3 mm (one exception in about 48 measurable skulls).

214. *Rattus fulvescens fulvescens* Gray, 1846. Synonyms, "*caudatior*" Hodgson, 1849, apparently "*gracilis*" Miller, 1913, and possibly "*jerdoni*" Blyth, 1863. (The external measurements in the original description of "*jerdoni*" suggest that this name might have been based on a form of the genus *Mus*.) About 60 specimens, including types of *fulvescens* and "*caudatior*", examined from Dhakuri and Khati, Kumaon; Apoon Hill (Gorkha), Bouzini, Chalna Khall and Hathibun, Nepal; Batasia, Chuntang, Ghoom, Gopaldhara, Lachen, Narbong and Pashok, all Sikkim or Darjiling district; Duragiri and Tura in the Garo Hills, Khasi Hills, and Naga Hills, all Assam; Dening and Dreyi, Mishmi; Hills east of Nam Tisang, and Pyaung-gaung (Shan States), Burma; Mount Mooleyit, Tenasserim (skulls). Some specimens bearing this name from the Punjab (Chalan Tissa, Deolah (Chamba), and Chatri) have the tail rather too short for the present species, and could be a form of *R. niviventer*.

430.(423). Tail less elongated, normally less than 140% of head and body length, in most specimens less than 130%.

Species 101. RATTUS NIVIVENTER Hodgson, 1836.

This is the first name in the present subgenus. As a species I include in it *Rattus confucianus* as understood by Glover Allen, from China, and *Rattus bukit*, as understood by Chasen, 1940, Handlist Malay Mammals. Perhaps *confucianus* is a synonym of true *niviventer*. Four subspecies occur in India.

431.(432). Underparts with distinct dark mid-ventral stripe or patch.

215. *Rattus niviventer lepcha* Wroughton, 1916. Six specimens, including the type, examined from Chuntang and Lachen in Sikkim.

432.(431). Underparts lack the dark mid-ventral stripe . . . . (433)

433.(434). Bullae exceed 13% of occipitonasal length; occipitonasal length appears not to exceed 33.5 mm.

216. *Rattus niviventer niviventer* Hodgson, 1836. About a dozen specimens (but only three unbroken skulls), including the type, examined from Simla, Punjab; Dhakuri, Kumaon; Katmandu, Lwarkhet, Satthar (Gorkha), and Thankot in Nepal; Mount Imaw Bum, 25 mi. N Myitkyina, and Mogaung, Burma. Some of these had been identified as *R. n. confucianus* Milne-Edwards, 1871, a Szechuan "race" which Anthony recorded from North Burma in 1941. I am not sure how this form can be distinguished from *niviventer*, which is the older name.

434.(433). Bullae most often less than 13% of occipitonasal length, which is more than 34 mm . . . . (435)

435.(436). Skull averages smaller; nine extralimital specimens average 36 mm in occitonasal length.

217. *Rattus niviventer bukit* Bonhote, 1903. Synonym, apparently, *"lepidus"* Miller, 1913. Typically from Jalor, Malay Peninsula. Two Indian specimens examined from Bankason in Tenasserim; also extralimital material, including the type.

436.(435). Skull averages larger; twenty-four specimens average 38 mm in occipitonasal length.

218. *Rattus niviventer mentosus* Thomas, 1916. In all, about 31 specimens, including the type, examined from Mokokchung, Naga Hills, Assam; Dibong, Sadiya; Digboi, near Lakhimpur; Dening and Dreyi, Mishmi; Adung Valley, 50 mi. E Fort Harz, Hkamti, 50 mi. W Kindat, Mode Forest (Mansi) and Nam Nat Valley, all in Burma.

437.(406). Bullae large, generally exceeding 15% of occipitonasal length. (Only in the form *R. nitidus obsoletus* are the bullae too small for the present subgenus. It is nearest *Rattus* (*Stenomys*) *mulleri* of those species above, but is smaller; its occipitonasal length less than 46 mm, whereas Indian specimens of *R. mulleri* usually have the occipitonasal length exceeding 50 mm.)

Subgenus RATTUS Frisch, 1775 (Fischer, 1803)

438.(439). Length of palate usually less than half the occipitonasal length (very rarely exceeding it); palatal foramina long, mostly about a fifth of occipitonasal length; bullae large, about 18% of occipitonasal length (which distinguishes this species from subgenus *Cremnomys*); tail of two colors, usually wholly dark basally, and wholly pale terminally.

Species 102. RATTUS BLANFORDI Thomas, 1881.

219. *Rattus blanfordi blanfordi* Thomas, 1881. About 30 specimens, including the type, examined from Jagodih, Lonra and Paresnath (Hazaribagh), Bihar; Mandla, Central Provinces; Khapa and Pachmarhi, Hoshangabad; Kolkaz, Pili (Sipna Valley), and Sembadoh, Berar; Khandesh; Matheran, Bombay; Khandalla; Ghatmatha, Satara; Sirsi, Kanara; Sivasamudram, Mysore; Kadapa, Madras; Kurumbapatti and Shevaroy Hill, Eastern Ghats; Machur, Palni Hills; Shernelly, Cochin.

439.(438). Length of palate usually clearly more than half the occipitonasal length; never combining the characters described above for *R. blanfordi* . . . . (440)

440.(441). Small species; length of occipitonasal in Indian specimens not exceeding 32.5 mm; tail wholly dark.

Species 103. RATTUS EXULANS Peale, 1848.

This is partly a parasitic species, and the typical race, which is larger than the form inhabiting India, was named from Islands in the Pacific. Other forms inhabit New Guinea, the larger Malay Islands, and the Malay States, and one form ranges northwards to Burma.

220. *Rattus ezulans concolor* Blyth, 1859. Thirty Indian specimens examined from Bhamo, Hkamti, Homalin, Kin, Pagan, Mount Poppa, Tamanthe, Toungoo, and Tatkon, all Burma; Maliwun and Tenasserim Town, Tenasserim; also considerable extralimital material.

441.(440). Length of occipitonasal, in Indian specimens, more than 36 mm . . . . (442)

442.(445). Tail normally of two colors, mostly dark above and pale below; or if, as in some individuals, concolor, then wholly pale.

Species 104. RATTUS RATTOIDES Hodgson, 1845.

443.(444). Underparts usually gray, and darker.

221. *Rattus rattoides rattoides* Hodgson, 1845. About 25 specimens, including the type, examined from Dhakuri and Khati, Kumaon; Ferping, Hathibun, Katmandu, Nagarcot and Thankot, Nepal; Ghoom, Darjiling and Chuntang, Sikkim.

444.(443). Underparts normally white.

222. *Rattus rattoides turkestanicus* Satunin, 1903. Synonym, probably, "*vicerex*" Bonhote, 1903. I cannot see how the latter differs from the former, and it appears that the name *turkestanicus* has priority. Fifty-five or more specimens, including the type of "*vicerex*", examined from Doongla-gali, North West Frontier Province; Berigi (Gilgit), Dangail (Kishtwar), Hydrabad, Kargil (Ladak), Mani (Wardwan), Poonch and Sardalla, Kashmir; Ara, Gandhala, Kallar-kahar, Sakesar (all Salt Range), Chakdulla, (Campbellpore); Bhurban, Lehtrar, Patriata and Sambli (all near Murree), Bara Tissa, Chatri, Chalan Tissa, and Kahlal, all Chamba district; Kothi, Pattan Valley, and Rahla, all Lahul, and Simla, all in Punjab; a few extralimital specimens.

445.(442). Tail usually of one color, wholly dark . . . . (446)

446.(447). Molars with cusps unusually angular and prominent; nasals not elongated (compare *R. nitidus*).

Species 105. RATTUS MONTANUS Phillips, 1932.

223. *Rattus montanus montanus* Phillips, 1932. Three specimens, including the type, examined from West Haputale (Ohiya), Ceylon. Apparently the peculiar dental characters easily distinguish this species, but it is not well known.

447.(446). Molars without peculiarities of the last species . . . . (448)

448.(451). Nasals long, usually exceeding or approximating 40% of occipitonasal length.

Species 106. RATTUS NITIDUS Hodgson, 1845.

This species occurs with *R. rattus* and *R. rattoides* in many places.

449.(450). Fur more harsh; tail averages about 99% of head and body length; bullae usually just under 15% of occipitonasal length; occipitonasal length less than 46 mm.

224. *Rattus nitidus obsoletus* Hinton, 1919. This is not a well known form. Three specimens, including the type, examined from 50–65 mi. W Kindat, west Burma.

450.(449). Fur usually more soft; tail averages longer than head and body; bullae usually exceeding or approximating 15% of occipitonasal length, as usual in the subgenus.

225. *Rattus nitidus nitidus* Hodgson, 1845. About 56 specimens, including the types of *nitidus*, "*pyctoris*" Hodgson, 1845, and "*aequicaudalis*" Hodgson, 1849, examined from Khati, Lohaghat and Lwarkhet, Kumaon; Changoo, Godaveri, Nagarcot, Ramchi, and Thankot, Nepal; Gangtok, Ghoom, Gopaldhara, Kalimpong, Mongpu and Pashok, all Sikkim or Darjiling district; Jowai, Khonshnong and Shangpung in Jaintia Hills, Assam; Dening, Mishmi; also a

few extralimital specimens. (One skin from Murree, Punjab, is probably misidentified.)

451.(448). Nasals shorter, less than 40% of occipitonasal length.

Species 107. RATTUS RATTUS Linnaeus, 1758.

This is the most widely distributed rodent in India. The typical race is from Sweden, and is parasitic. The species was revised in some detail by Hinton, who divided it, in India, into a large number of subspecies. I have followed that author where possible. It must be borne in mind that one is dealing with very large numbers of specimens, but a provisional key to the better known Indian races would work out on the following lines.

452.(473). Underparts usually white or dirty white or lighter, (*i.e.*, as far as known, a wild subspecies. In this species, the wild light-bellied races frequently occur with the house-dwelling or parasitic dark or dull-bellied races. Exceptions to the color of the underparts as just mentioned are most often found in the races *tikos*, *khyensis*, *wroughtoni* and in a small degree *gangutrianus*, but whitish-bellied specimens are in the majority in all these forms) . . . . (453)

453.(454). Tail unusually long, generally exceeding 150% of head and body length; upper toothrow long, usually about 6.9 mm.

226. *Rattus rattus satarae* Hinton, 1918. About 10 specimens, including the type, examined from Konkan; Ghatmatha, and Helwak, Satara district; Chettiri Range, Salem, and Shevaroy Hill, Eastern Ghats.

454.(453). Tail averages less than 150% of head and body length . . . . (455)

455.(462). Upper toothrow usually not exceeding 6.6 mm; in individual exceptions, usually less than 16% of occipitonasal length (western subspecies) . . . . (456)

456.(461). Length of tail usually more than 130% of head and body length . . . . (457)

457.(458). Occipitonasal length most often approximates or exceeds 41 mm.

227. *Rattus rattus arboreus* Horsfield, 1851. Sixteen specimens examined from Hazaria, Nepal Terai; Cawnpore, U.P.; Jalpaiguri, Bengal; Dantongunj, Gajhundi, Paresnath and Singar, Bihar.

458.(457). Occipitonasal length most often not reaching 41 mm . . . . (459)

459.(460). Bullae usually approximate or exceed 17% of occipitonasal length.

228. *Rattus rattus narbadae* Hinton, 1918. Synonym, apparently, *"girensis"* Hinton, 1918. About 20 specimens, including types of both names just listed, examined from Sasan, Kathiawar; Dhain, Rorighat, and Sakot, Hoshangabad; Sonawahnee, Balaghat; Chichpalli, Chanda.

460.(459). Bullae usually less than 17% of occipitonasal length.

229. *Rattus rattus kandiyanus* Kelaart, 1850. Synonym, *"tetragonurus"* Kelaart, 1850. About 32 specimens, including types of both names just listed, examined from Anasigalla, Colombo, Hambantota, Kandy, Kumbukkan, Maha-oya, Mankeni, Udugama, Urugalla, Valaichenai, Wellawaya, all in Ceylon.

461.(456). Length of tail usually less than 130% of head and body length.

230. *Rattus rattus wroughtoni* Hinton, 1919. More than 40 specimens, including the type, examined from Dharwar; South Mahratta; Gersoppa, Kanara; Bangalore, Kardibetta Forest, Kolar, Sagar and Seringapatam, Mysore; Haleri and Wotekolli, Coorg; Coonoor, Kotagiri, Ootacamund in Nilgiri Hills, Silver Cascade and Perumal (? Nilgiri Hills); Shambalgamur, Palni Hills; Seetragund, Malabar; Kotengady Estate and Shernelly, Cochin; Poumudi and Trivandrum, Travancore.

462.(455). Upper toothrow usually 6.6 mm or more; in individual exceptions usually exceeds 16% of occipitonasal length (northern and eastern subspecies) . . . .(463)

463.(464). Tail usually less than 110% of head and body length, sometimes shorter than head and body.

231. *Rattus rattus tikos* Hinton, 1919. About 30 specimens, including the

type, examined from Bankason, Lampea, Tenasserim Town, Tagoot, Thaget, Victoria Island, Victoria Point, all Tenasserim; King Island, Malcolm Island, Sullivan Island, all Mergui Archipelago.

464.(463). Tail usually more than 110% of head and body length . . . . (465)

465.(466). Tail length usually less than 120% of head and body length.

232. *Rattus rattus khyensis* Hinton, 1919. Synonym, "*tatkonensis*" Hinton, 1919, which cannot be distinguished in our material from *khyensis*. About 34 specimens, including the types of both names just listed, examined from Gokteik, Hsipaw, Kin, Kyauknaung, 6–25 mi. W Kindat, Maymyo, Madaya, Mingun (near Sagaing), Nyapinium, Mount Poppa, Pyaung-gaung, Schwebo, Tatkon, near Toungoo, all in Burma.

466.(465). Tail length usually exceeds 120% of head and body length . . . . (467)

467.(470). Tail long, usually more than 130% of head and body length . . . . (468)

468.(469). Length of bullae in adult skulls exceeds 6.6 mm; dorsal coloration slightly lighter.

233. *Rattus rattus bhotia* Hinton, 1918. Sixteen specimens examined from Hasimara in Bhutan Duars, including the type.

469.(468). Length of bullae, in the few specimens available, not exceeding 6.6 mm; dorsal coloration slightly darker.

234. *Rattus rattus macmillani* Hinton 1919. Four specimens, including the type, examined from Hkamti (west bank Chindwin River), Burma.

470.(467). Tail more moderate in length, usually less than 130% of head and body length . . . . (471)

471.(472). Bullae usually exceed 17% of occipitonasal length.

235. *Rattus rattus gangutrianus* Hinton, 1919. About 35 specimens, the type included, examined from Khati, Lohaghat, Lwarkhet, Ranibagh, Ratighat, Sitabani (Ramnagar), and Takula in Kumaon; Bara Tissa, Chamba, Dharmsala, Gopalpur, Kyelang and Jagatsukh, in Punjab.

472.(471). Bullae usually less than 17% of occipitonasal length.

236. *Rattus rattus brunneusculus* Hodgson, 1845. Synonym, "*sikkimensis*" Hinton, 1919. I do not see how the latter can be separated from the former. *Brunneusculus* is the first name for a light-bellied subspecies in India. About 56 specimens, including types of both names just listed, examined from Bishampur and Lake Loktak in Manipur; Naga Hills, and Tura and Durabanda in Garo Hills, Assam; Dening and Dreyi, Mishmi; Chakung, Gangtok, Gopaldhara, Kalimpong, Pashok, Ringin, Rongli and Singhik, all in Sikkim or Darjiling district; Bouzini, Chalna Khall, Deosali (Gorkha), Kakani, Mircourt, Nagarcot, Nan Glepany, Patibaghan, Sipuri and Sunachurn, Nepal.

473.(452). Underparts usually dull or dark, (*i.e.*, so far as known, essentially parasitic or house-dwelling types. About a quarter of the specimens of *tistae*, some of them perhaps wrongly identified, are more white-bellied, and some individual exceptions to the above statement occasionally occur in *brunneus* and *kelaarti*) . . . . (474)

474.(477). Upper toothrow usually 6.6 mm in length or more; in individual exceptions, usually more than 16% of occipitonasal length (northern and eastern subspecies) . . . . (475)

475.(476). Occipitonasal length not less than 42 mm.

237. *Rattus rattus brunneus* Hodgson, 1845. Eleven specimens, including three co-types, examined from Changoo, Ferping, Godaveri, Hathibun, Katmandu and Sipuri, all in Nepal.

476.(475). Occipitonasal length not reaching 42 mm (with one exception).

238. *Rattus rattus tistae* Hinton, 1918. More than 70 specimens, including the type, examined from Lake Loktak, Manipur; Dibong, and Lohit Valley, Sadiya; Dening, Mishmi; Digboi, Lakhimpur; Gologhat and Margherita in

Naga Hills, Cherrapunji in Khasi Hills, and Tura in Garo Hills, all Assam; Angarakhata, Kamrup; Batasia, Gopaldhara, Gangtok, Kalimpong, Narbong, Pashok, and Rongli, all Sikkim or Darjiling district.

477.(474). Upper toothrow rarely reaching 6.6 mm in length (western subspecies) . . . .(478)

478.(481). Tail apparently less than 120% of head and body length in most specimens . . . . (479)

479.(480). Fur thicker; underparts averaging lighter; in most specimens available, length of bullae 6.4 mm at most.

239. *Rattus rattus kelaarti* Wroughton, 1915. About 22 specimens, including the type, examined from Ambawela, Pattipola and West Haputale, Ceylon.

480.(479). Fur shorter; underparts averaging darker; in specimens examined, length of bullae at least 6.5 mm.

240. *Rattus rattus nemoralis* Blyth, 1851. Fifteen specimens, including the type, examined from Colombo, Hambantota, Kandy, Mannar, Trinco, all in Ceylon.

481.(478). Tail usually more than 120% of head and body length.

241. *Rattus rattus rufescens* Gray, 1837. About 87 specimens, including a type and the type of "*flavescens*" Elliot, 1839, examined from Pilibhit, Rohilkund, and Ramnagar, Kumaon; Ara (Salt Range), Pathankote, and Rawalpindi, Punjab; Pano Aqil and Umankot, Sind; Bhuj, Cutch; Mount Abu, Rajputana; Danta and Palanpur, Gujerat; Junagadh, Keshod, and Rajkot, Kathiawar; Gwalior; Chichpalli, Chanda; Sonawahnee, Balaghat; Pili, Sipna Valley, Berar; Bori, Dhain, and Sakot, Hoshangabad; Asirgarh, Chandgarh and Ganoor, Nimar; Hariseh, Berar; Bhadgaon and Ghodesgaon, Khandesh; Ghatmatha and Helwak, Satara; Dharwar and Gadag, Dharwar district; Hubli, South Mahratta; Gersoppa, Kanara; Vijayanagar, Bellary; Bangalore, Kolar and Seringapatam, Mysore; Balapalli, Cuddapah; Coonoor, Nilgiri Hills; Kurumbapatti, Salem district.

I am not able to include in the key four other named subspecies that occur in Indian territory. About eleven Indian specimens from Pasri, Baluchistan, Chakdulla, Campbellpore in Punjab, and Gambat, Jacobabad, Kashmor and Sukkur in Sind, have been referred to *Rattus rattus alexandrinus* Geoffroy, 1803, which was named from Egypt and is the common southern European parasitic form. This name antedates *rufescens*. According to Hinton, the dorsal color is rufous, and the hair of the belly has a rusty tinge in *rufescens* whereas in *alexandrinus*,the dorsal color is rarely rufous and the belly lacks the rusty tinge. I cannot, however, see much difference between specimens referred to the two forms from Indian material examined. I have seen two Indian specimens, from Bombay and Gersoppa, Kanara, referable to *Rattus rattus rattus* Linnaeus, 1758, which was named from Sweden and is a melanistic parasitic form. A specimen from Gilgit apparently represents *alexandrinus*. Owing to paucity of material, I am not able to place *Rattus rattus andamanensis* Blyth, 1860, in the key. We have two specimens, from the Andaman Islands (Narcondam and no exact locality), including the type. The toothrow is long, 7.5 mm or more, but our skins lack measurements. I have seen no skulls for *Rattus rattus dentatus* Miller, 1913, which is named from Hastings Island, Mergui Archipelago. We have about 10 skins, from Criddles Island, Hayes Island, Hastings Island, Ross Island, and Tavoy Island, all Mergui Archipelago, which I would refer to this race. They were identified as *R. r. tikos*, from which they differ by their darker bellies.

Yet another species of *Rattus* has been taken in Indian territory, *Rattus norvegicus* Berkenhout, 1769, a parasitic species which ranges throughout the world. It seems not to be a native of India, and I have seen only four specimens from Indian territory, a skin in bad condition, from Ceylon, the remainder from Calcutta. This species differs from *Rattus rattus* by its narrowed brain-

case, shortened, obscurely bicolor tail, heavily ridged skull (at least in old individuals), and powerful zygomatic plate which is strongly thrown forwards.

482.(365). Upper toothrow specialized by enlargement of M^1 so that it is normally more than half the length of toothrow, combined with distortion inwards of antero-internal cusp, and strong to extreme reduction of M^3; anterior root of M^1 usually much projected forwards; small mice generally, occipitonasal length rarely as much as 29 mm, very rarely as much as 30 mm.

Genus MUS Linnaeus, 1758

No general revision of this genus in India has recently been attempted. There seems good reason for retaining about eight species, which are based mainly on average rather than absolute characters. One of them, *mayori*, has hitherto been separated generically as *Coelomys*, but its characters are not of generic value when detailed work is done, and it seems wisest to refer it to *Mus* as a subgenus. Another species, *M. pahari*, resembles it to a certain extent in some peculiarities, and differs sharply from the other *Mus* species of India, and I provisionally regard it also as subgenerically separable from typical *Mus*, and refer it to the subgenus *Coelomys*.

483.(490). Palatal foramina shortened, normally less than one-fifth of occipitonasal length.

Subgenus COELOMYS Thomas, 1915

484.(487). Larger species; occipitonasal length usually exceeds 27 mm; upper toothrow exceeds 4 mm; diastema usually exceeds 7 mm; hindfoot 23 mm or more.

Species 108. MUS MAYORI Thomas, 1915.

485.(486). Underparts pure white

242. *Mus mayori pococki*, new name, for *"bicolor"* Thomas, 1915, not *Mus musculus* var. *bicolor*, Tichomirov and Kortchagin, 1889, Bull Soc Amis. Sci. Nat. Moscou, vol. LVI, livr. 4, p. 26, (Kirghiz Steppe). Named after Mr. R. I. Pocock of the British Museum, who has done so much for Indian Mammalogy. Three specimens, including the type, examined from Kottawa and Mousekande, Ceylon (the first is the type locality).

486.(485). Underparts dark, or at most with white coloration only suggested and mixed with a considerable portion of brown.

243. *Mus mayori mayori* Thomas, 1915. Ten specimens, including the type, examined from Pattipola and West Haputale, Ceylon.

487.(484). Smaller species; occipitonasal length usually less than 26 mm; length of upper toothrow less than 4 mm; diastema less than 7 mm; hindfoot usually less than 23 mm.

Species 109. MUS PAHARI Thomas, 1916.

488.(489). Occipitonasal length usually exceeds 25 mm (4 exceptions in 14 skulls).

244. *Mus pahari pahari* Thomas, 1916. Fifteen specimens, including the type, examined from Batasia, Chuntang, and Pashok, in Sikkim or Darjiling district; Lohit Valley, Sadiya; Gologhat in Naga Hills, Assam; Nam Tamai, Upper Burma.

489.(488). Occipitonasal length usually not reaching 25 mm (one exception in 15 skulls).

245. *Mus pahari jacksoniae* Thomas, 1921. Seventeen specimens, including the type, examined from Tura in Garo Hills, Laitkynsao in Khasi Hills, Khonshnong in Jaintia Hills, Mokokchung in Naga Hills, all Assam; Dening and Dreyi, Mishmi; Nam Tisang, North Burma. I have reason to think that this or a similar form occurs in Manipur.

490.(483). Palatal foramina lengthened, normally clearly more than one-fifth of occipitonasal length.

Subgenus MUS Linnaeus, 1758

Currently divided into about three genera in India, *Mus*, *"Leggada"*, *"Leggadilla"*. The last two names are based on such hopelessly inconstant characters when compared with typical *Mus* that they have no value even for subgeneric purposes when large numbers of specimens are examined.

491.(524). Diastema usually approximates or exceeds one-quarter of occipitonasal length, (*i.e.*, muzzle less shortened). (Individual exceptions in the four species that follow are; for *Mus booduga*, 16 in 44 skulls; for *Mus cervicolor*, about 13 in 51 skulls; for *Mus famulus*, 2 in 17 skulls, and for *Mus platythrix*, about 12 in 60 skulls, including some young ones. Young specimens usually tend to have the diastema short) . . . . (492)

492.(495). Very small species; occipitonasal length usually less than 20 mm (about 13 exceptions in 44 skulls). This species occurs in many places with *Mus platythrix* and *Mus cervicolor* as here understood.

Species 110. MUS BOODUGA Gray, 1837.

493.(494). Length of tail normally less than 80% of head and body length.

246. *Mus booduga lepidoides* Fry, 1931. Nine specimens examined from Mount Poppa, Burma.

494.(493). Length of tail most often exceeds 90% of head and body length.

247. *Mus booduga booduga* Gray, 1837. As here understood, includes as synonyms *"lepidus"* Elliot, 1839, *"terricolor"* Blyth, 1851, *"dunni"* Wroughton, 1912. About 108 specimens, including types of *booduga* and *"dunni"*, examined from Hasimara and Bharnabhari in Bhutan Duars (but specimens from these localities might represent *M. cervicolor nagarum*); Almora, Bageswar, Dela, Lohaghat, Pilibhit (Rohilkund), Sitabani, all Kumaon; Ambala, Handisera, and Rawalpindi, Punjab; Nokania, Cutch; Danta, Deesa, Lunwa, all Gujerat; Motimojiti, Muli, Rajkot, Vankaneer, all Kathiawar; Barkagaon, Daltongunj, and Nimiaghat (Hazaribagh), Bihar; Koira and Luia (Chaibassa), Orissa; Bori, Dhain, Pachmarhi, and Rorighat, Hoshangabad; Oudh and Sonawahnee, Balaghat; Chanda, Central Provinces; Mundra, Sangor; Asirgarh and Chandgarh, Nimar; Pili, Berar; Khandesh; Khandalla; Poona; Helwak, Satara; Khed and Shirgaon, Ratnagiri; Dharwar and Gadag, Dharwar district; Vijayanagar, Bellary; Balapalli Range, Cuddapah; Bangalore and Kardibetta Forest, Mysore; Kutta, Coorg; Ootacamund, Nilgiri Hills; Chettiri Range and Tirthemalai (Salem), Eastern Ghats.

495.(492). Less small species; occipitonasal length generally exceeds 20 mm (about 6 exceptions in 51 skulls for *Mus cervicolor*) . . . . (496)

496.(507). Medium sized species; occipitonasal length usually not reaching 23 mm.

Species 111. MUS CERVICOLOR Hodgson, 1845.

This represents a group of subspecies which occurs in various places with *M. booduga* and *M. famulus* as here understood.

497.(498). Underparts white; fur spiny.

248. *Mus cervicolor phillipsi* Wroughton, 1912. Synonym, apparently, *"surkha"*, Wroughton and Ryley, 1913. Fifteen specimens, including the types of both names just listed, examined from Mount Abu, Rajputana; Danta, Gujerat; Asirgarh, Nimar; Chikalda, Berar; Vijayanagar, Bellary; Balapalli Range, Cuddapah; Kurumbapatti, Salem district. I cannot find characters to separate *"surkha"* from *phillipsi*. This race stands rather apart from the other races here referred to *Mus cervicolor*. It was formerly associated with *Mus platythrix*, etc. in *"Leggadilla"*-mice with supraorbital ridges developed on the skull. But these ridges vary in development, and can be present, individually, in any race of *Mus* as here understood, and do not seem to be even of specific value.

498.(497). Underparts gray or grayish white; fur mostly soft . . . . (499)

499.(502). Tail usually exceeds head and body length .... (500)

500.(501). Palatal foramina exceed 23% of occipitonasal length; palate proportionately longer.

249. *Mus cervicolor cervicolor* Hodgson, 1845. About 9 specimens, including co-types, and type of "*strophiatus*" Hodgson, 1845, examined from Bouzini, Hazaria (Patheghatta), Sipuri and Tribeni, Nepal. A skin bearing this name from Kindat in West Burma probably represents *M. c. nitidulus*.

501.(500). Palatal foramina usually less than 22% of occipitonasal length; palate proportionately shorter.

250. *Mus cervicolor palnica* Thomas, 1923. Twelve specimens, including the type, examined from Kardibetta Forest, Mysore; Haleri Estate and Kutta, Coorg; Coonoor, Kotagiri, Kodai-kanal and Perumal, Nilgiri Hills, and Shambalgamur in Palni Hills.

502.(499). Tail usually shorter than head and body length .... (503)

503.(504). Tail most often less than 90% of head and body length.

251. *Mus cervicolor nitidulus* Blyth, 1859. Twelve specimens examined from Kin, Mandalay, 12–40 mi. SE Pegu, and perhaps Kindat, Burma (see note under *M. c. cervicolor* above).

504.(503). Tail most often more than 90% of head and body length .... (505)

505.(506). Underparts average lighter, whitish gray.

252. *Mus cervicolor fulvidiventris* Blyth, 1852. Thirteen specimens (but only three skulls measurable) examined from Ambawela, Cheddikulam, Kottawa, Mankeni, Maha-oya, Urugalla, all in Ceylon. This form is usually regarded as representing *Mus booduga*, and I am not sure of its status. But on the material I have examined it seems to belong to the present species, and I provisionally transfer it here.

506.(505). Underparts average darker, duller gray.

253. *Mus cervicolor nagarum* Thomas, 1921. Thirty-one specimens, including the type, examined from Dening, Mishmi; Gologhat in Naga Hills, Khonshnong and Shangpung in Jaintia Hills, Laitkynsao in Khasi Hills, Assam; Angarakhata and Rajapara, Kamrup. This form is very close to *M. c. nitidulus*.

507.(496). Large species; occipitonasal length most often exceeds 23 mm (about 5 exceptions, 3 of them not fully adult, in roughly 77 skulls) .... (508)

508.(513). Underparts yellowish or darkish gray, not white; in western subspecies, tail length exceeds 90% of head and body length. In the Burmese subspecies, which occurs with a race of *Mus platythrix* (*M. p. shortridgei*), the occipitonasal length is less than 24 mm.

Species 112. MUS FAMULUS Bonhote, 1898.

This is a somewhat provisional species as here understood, but as it occurs with *M. cervicolor* both in West India and in Assam, it seems reasonable to place these three present subspecies together. *M. f. famulus* is however very different from the other two races, and *popaeus* is not widely removed from *M. cervicolor nitidulus*.

509.(510). Color deep dark brown, the underparts slightly lighter and washed with ochraceous; tail apparently nearly wholly dark, and more than 90% of head and body length (a rare form).

254. *Mus famulus famulus* Bonhote, 1898. Two specimens, including the type, examined from Coonoor in the Nilgiri Hills.

510.(509). Color lighter brown, the underparts lighter, greyish; tail clearly bicolor .... (511)

511.(512). Tail averages more than 90% of head and body length; underparts darker.

255. *Mus famulus cooki* Ryley, 1914. Twenty-two specimens, including the type, examined from Gokteik (Shan States); Kabaw Valley, 20–50 mi. W of Kindat, West Burma; Madaw, Manipur; Naga Hills, Assam.

512.(511). Tail averages less than 90% of head and body length; underparts slightly lighter.

256. *Mus famulus popaeus* Thomas, 1919. Seven specimens, including the type, examined from Bhamo and Mount Poppa in Burma (the latter the type locality).

513.(508). Underparts tend to be white (except in the Burmese race, in which they are light gray); in all subspecies, tail averages less than 90% of head and body length. In the Burmese subspecies, which occurs with a race of *M. famulus* (*M. f. popaeus*), occipitonasal length of skull exceeds 27 mm.

Species 113. MUS PLATYTHRIX Bennett, 1832.

This species occurs in many places with *M. booduga*, *M. famulus* and *M. cervicolor*, and antedates all of them. Usually the skull has supraorbital ridges, but these may occur elsewhere individually in any Indian form of the present genus. In this species the fur tends to be bristly or spiny. I include as subspecies all forms heretofore referred to "*Leggadilla*", except *phillipsi*, *surkha* and *fernandoni*.

514.(517). Palatal foramina shorter, approximating 22% of occipitonasal length at most, but usually less . . . . (515)

515.(516). Dorsal coloration averages slightly darker.

257. *Mus platythrix grahami* Ryley, 1913. I have reason to believe that this may have to be called *M. p. bahadur*, Wroughton and Ryley, 1913, which has priority. That name was based on a single old specimen and is little known. I regard "*hannyngtoni*" Ryley, 1913, as a synonym based on very old specimens. About nine specimens, including types of the three names just listed, examined from Makut and Wotekolli, Coorg; Karwar, Kanara (type locality of *bahadur*).

516.(515). Dorsal coloration averages slightly paler.

258. *Mus platythrix gurkha* Thomas, 1914. Six specimens, the type included, examined from Bageswar and Jerna (Ramnagar) in Kumaon, Paresnath (Hazaribagh) and Singar (Gaya), Bihar.

517.(514). Palatal foramina longer, exceeding 23% of occipitonasal length . . . . (518)

518.(519). Underparts light gray; hindfoot 20 mm at least; length of head and body normally exceeds 100 mm.

259. *Mus platythrix shortridgei* Thomas, 1914. Twelve specimens, including the type, examined from Mingun (near Sagaing), Mount Poppa and Pagan in Burma.

519.(518). Underparts usually white; hindfoot usually less than 20 mm (about 3 exceptions in 65 skins); length of head and body most often less than 100 mm . . . . (520)

520.(521). Occipitonasal length most often more than 25 mm.

260. *Mus platythrix platythrix* Bennett, 1832. Synonym, "*saxicola*" Elliot, 1839, Madras Jour. Lit. Sci., X, p. 215. About 30 specimens, including types of both names just listed, examined from Damthal (Kangra), Punjab; Rorighat, Hoshangabad; Chikalda, Berar; Asirgarh, Nimar; Poona; Matheran, Bombay; Ahmednaggar; Ghatmatha, Satara; Khandalla; Khed and Shirgaon, Ratnagiri; Konkan; Dharwar and Hawbshavi, Dharwar district; Sivasamudram, Mysore; Ootacamund, Nilgiri Hills; Madras; Travancore.

521.(520). Occipitonasal length rarely reaches 25 mm (5 exceptions in 23 skulls) . . . . (522)

522.(523). Back usually gray in color.

261. *Mus platythrix sadhu* Wroughton, 1911. Synonyms, "*cinderella*" Wroughton, 1912 (apparently based on young specimens of this race), "*Pyromys priestlyi*" Thomas, 1911, is I think a composite "genus" based on a skin of this subspecies mixed with a skull of *Millardia gleadowi*. About 22 specimens, including types of the three names just listed, examined from Lehore district, Punjab; Virawah, Sind; Mount Abu, Rajputana; Bhuj, Chalwar, Dhonsa, Padampur, all Cutch; Dhrangadhra, Kudia, Muli, Satapur and Vankaneer, all Kathiawar.

523.(522). Back usually brown, often pinkish brown, in color.

262. *Mus platythrix ramnadensis* Bentham, 1908. Synonym, "*siva*" Thomas and Ryley, 1913. About 17 specimens, including the type of "*siva*", examined from Kodura and Palkonda, Balapalli Range, Cuddapah; Sivasamudram, Mysore; Chettiri Range and Tirthemalai, Salem district; Cumbum and Ramnad, Madura (South Madras).

524.(491). Diastema usually short, normally less than one-quarter of occipitonasal length (*i.e.*, muzzle shortened). (In India, there are 9 exceptions out of more than 150 specimens of *M. musculus*) . . . . (525)

525.(526). Occipitonasal length approximates 23 mm at lowest; upper toothrow 3.8–4.2 mm. Species 114. MUS FERNANDONI Phillips, 1932.

263. *Mus fernandoni fernandoni* Phillips, 1932. Two specimens, including the type, examined from Kumbalgamuwa in Ceylon. This is a little known species, which resembles *Mus platythrix* in a general way, except for its apparently shortened muzzle.

526.(525). Occipitonasal length very rarely reaches 23 mm; upper toothrow less than 3.8 mm in skulls I have measured.

Species 115. MUS MUSCULUS Linnaeus, 1758.

Typically from Sweden. For a recent revision of this species see Schwarz and Schwarz, 1943, Jour. Mamm., vol. 24, p. 59. In India there appear to be three main types, although the authors just mentioned recognize five by a further division of the dark-bellied indoor parasitic mice.

527.(530). Underparts white, whitish gray or light gray . . . . (528)

528.(529). Dorsal coloration averages lighter.

264. *Mus musculus bactrianus* Blyth, 1846. Typically from Afghanistan. About 88 specimens examined from Kagan Valley, Hazara; Dulai and Kerrim, Kashmir; Dras, Ladak; Banni, Lehtrar and Patriata, near Murree, Bhattu Hissar, Chakdulla and Jhalar, both Campbellpore, Ara, Jhelum, Kallar-kahar, Rohtas and Sakesar (all Salt Range), Rawalpindi, Sialkot and Siwalik Hills, all in Punjab; Bambier, Kach, Kalegar, Kelat, Khojdar, Mustang, 16 mi. NE Mand, Pangjur, Quetta, Sourab, Turbat and west of it, all Baluchistan; Chak, Gambat, Jacobabad, Jeypur, Kashmor, Naundero and Umankot, Sind; also extralimital material. The type is in London.

529.(528). Dorsal coloration averages darker.

265. *Mus musculus homoourus* Hodgson, 1845. About 100 specimens, including the type, and the type of "*darjilingensis*" Hodgson, 1849, which is said to be a synonym, examined from Chatta, Chichoti, Chakothi, Dachgam, Dangail (Kishtwar), Dras (Ladak), Kul, Kerrim, Kargail (Ladak), Mani (Vale of Kashmir), Pandritton, Prastan, Sangi, Shar and Thelum River, all in Kashmir (these specimens are not very typical owing to their relatively short tails); Chatri, Siluni and Tissa (all Chamba), Dagshai, Damthal, Dharmsala, and Gopalpur, all Punjab; Khati, Lwarkhet, Lohaghat (Almora), and Ratighat (Naini Tal), all Kumaon; Apoon Sottidanda, Laprak and Satthar, all Gorkha, Nepal; Batasia, Chuntang, Gopaldhara, Kalimpong, Nimbong, Pashok, Pedong, Rongli, Sangser, Sukiapohkri and Tonglu, all Sikkim or near Darjiling; (Naga Hills, Assam, one skull, perhaps a misidentification); Guna in Central India; Coonoor, Nilgiri Hills, and Shevaroy Hill, Eastern Ghats in southern India. The specimens from Sangser can only be provisionally referred to this form; cranially they are more like a form of *Mus cervicolor*.

530.(527). Underparts dark brown or dull.

266. *Mus musculus castaneus* Waterhouse, 1843. Schwarz and Schwarz divide the Indian house-mice into three nominal races, *castaneus*, which was named from the Philippine Islands, being the first named; synonym, "*manei*" Kelaart, 1852; *urbanus*, Hodgson, 1845, (synonym, "*dubius*" Hodgson, 1845,

preoccupied); and *tytleri* Blyth, 1859. I have examined about 160 specimens of dark-bellied Indian house-mice, including the types of "*dubius*" and "*manei*". Indian house-mice seem to differ from the European typical race and its Palaearctic allies by having the tail proportionately longer. Specimens examined from the following localities: Andaman Islands (skull); Gokteik, Maymyo, Monywa, Pagan, Rangoon, all Burma; Shangpung, Jaintia Hills, and Margherita, Naga Hills, Assam; Lanka, Cachar; Angarakhata and Rajapara, Kamrup; Ghoom, Gopaldhara, Kalimpong, Pashok, Pedong, Rongli, Sedonchen, Tongsong, and west of Tista River, all Sikkim or Darjiling district; Patibaghan, Nepal; Jerna, Ramnagar and Pilibhit, Rohilkund, Kumaon; Ambala, Damthal (Kangra), and Hissar district, Punjab; Delhi; Bhuj, Cutch; Rajkot and Sasan, Kathiawar; Deesa, Palanpur; Luia, Chaibassa (Orissa), Daltongunj, Bihar, Jalpaiguri and Salbani (Midnipur), Bengal; Gajhundi and Nimiaghat, Hazaribagh; Ajmere; Thana (65 mi. N Bombay); Poona; Surat district; Helwak, Satara; Gadag, Mahratta; Dharwar; Gersoppa, Kanara; Bangalore, Kolar and Sagar, Mysore; Haleri Estate and Virajpet, Coorg; Kotagiri and Ootacamund, Nilgiri Hills; Ambawela, Cheddikulam, Colombo, Kandy, Trinco, Udugama, Urugalla, and West Haputale, all Ceylon.

The British Museum (Natural History), London, England.

BATS FROM THE SOLOMON ISLANDS

By Colin Campbell Sanborn and William J. Beecher

Among numerous collections of mammals received by the Chicago Natural History Museum from men serving in the Army and Navy during World War II is one from the Solomon Islands made by the junior author.

Mr. Beecher was initially attached to the 118th Medical Battalion of the 43rd Division and later, from April 1943 to December 1945, served with various Malaria Control Units. He collected on Guadalcanal, New Georgia, and Bougainville islands in the Solomons and on Banika Island in the Russell Group. One of the fruit bats and three of the Microchiroptera are recorded from the Solomons for the first time.

The bats from New Georgia came from a cave about three miles north of Munda Point. It was hidden in dense jungle and Beecher was guided there by a native who had had a small garden near it before the Japanese invaded the island. The entrance was a large room about 50 feet high from which a passage descended 15 feet to gallery running at right angles to the entrance. This gallery was about 40 feet high by 20 wide. The floor was covered by a stream six inches deep inhabited by many eels. About 50 yards down it were three or four smaller chambers nearly filled with bat guano. Beecher was not able to explore any deeper. All parts of the cave were inhabited by bats, estimated at some thousands.

On Guadalcanal Island another cave inhabited by bats was located. This was near Bloody Ridge, which was four or five miles inland from Kukum Docks, these being about two miles west of Lunga Point. This cave ran zig-zag through the hill a distance of about 50 yards with an opening on the other side. It was

about 40 feet high and in the center the floor dropped away and passage was made on a ledge on one side. The depth here was not ascertained but water was heard running far below. An estimated 50 bats were seen in this cave.

At the other locality on Guadalcanal, the mouth of the Little Teneru River, and on Bougainville and Banika islands, bats were collected by shooting them on the wing.

Every evening at Teneru River the fruit bats came from their roosts in the hills inland to the coconut groves that stretched for 30 miles along the north coast from Koli Point on the east to Doma Cove on the west. All night they could be heard feeding and fighting and flapping among the trees. A few roosted in the grove during the day but the majority left and their place was taken by numerous flocks of lories (*Trichoglossus haematodus* and *Eos cardinalis*) which returned to the hills at dusk just before the bats arrived.

The fruit-bats appeared to be feeding on the flowers and up to medium-sized fruits of the coconut palm. The fruit they opened and that they knocked to the ground attracted flies that seemed to be the cause of almost universal dysentery among the troops.

About one-third of all the bats examined were infected with malaria, the blood smears showing some form of *Plasmodium*. The same proportion of birds was infected and 80 percent of the natives. A specimen of *Pteropus woodfordi* was found helpless at the foot of a tree one morning. Examination showed no injury but blood tests revealed parasites, probably *Plasmodium* which may have been the cause of its condition.

ANNOTATED LIST

Pteropus hypomelanus luteus Andersen

Pteropus hypomelanus luteus K. Andersen, Ann. Mag. Nat. Hist., series 8, vol. 2, p. 362, 1908.

Specimens collected.—**Russell Islands:** Banika Island, 1 female (alc. skull cleaned).

This race ranges from New Guinea east to Woodlark Island which is about 360 miles west of Banika Island. The present specimen is externally about the size of *luteus*, but the skull is smaller and the color much darker. It is considered very possible that it represents a dark phase, stated by Andersen to be common in some races of *hypomelanus* but unknown in *luteus*. There being but one specimen, it is referred to *luteus* for the time being.

The general color of the back, throat, and belly are dark Prout's Brown (Ridgeway), much lightened on the back by an abundance of long silky hairs of silver-gray and ochraceous, this general color passing into Mummy Brown on the rump. The mantle is pale, dull Dresden Brown becoming grayish-buff posteriorly and ochraceous on the sides, the color deepening to form a narrow indistinct band across the upper breast. The head is grayish-brown, an admixture of the predominant Mummy Brown with an abundance of frizzly silver-gray hairs that grade posteriorly into ochraceous to produce the mantle color. There is a noticeable admixture of silver-gray and a few ochraceous hairs on the belly and throat, but not sufficient to affect the general dark coloration. It differs from *luteus* mainly by the uniformly dark under parts which in *luteus* are some shade of buff.

Measurements.—Forearm 132 mm. Skull (braincase broken): palation to incisive foramina, 28.8; front of orbit to tip of nasals, 19.4; width of braincase at zygomata, 20.6; zygomatic width, 30.6; width across m^1 externally, 16.5; lachrymal width, 11.6; width across canines externally, 11.8; postorbital constriction, 7.3; interorbital constriction, 8.3; orbital diameter, 11.4; upper toothrow c-m^3, 21.8; lower toothrow, c-m_3 24.6.

Pteropus solomonis Thomas

Pteropus solomonis Thomas, Nov. Zool., vol. 11, p. 597, 1904.

Specimens collected.—**Solomon Islands:** Teneru River, Guadalcanal Island, 3 males, 1 female. **Russell Group:** Banika Island, 1 female.

Fairly common on Guadalcanal. Forearms measure from 104 to 115 mm.

Pteropus rayneri Gray

Pteropus rayneri Gray, Cat. Monk., etc., p. 108, 1870.

Specimens collected.—**Solomon Islands:** Teneru River, Guadalcanal Island, 2 males, 3 females.

This was the common large species on Guadalcanal. In flight it was slow and ponderous. The forearms measure 137–138 mm.

Pteropus woodfordi Thomas

Pteropus woodfordi Thomas, Ann. Mag. Nat. Hist., series 6, vol. 1, p. 156, 1888. Guadalcanal Island, Solomon Islands.

Pteropus austini Lawrence, Proc. New England Zool. Club, vol. 23, p. 59, 1945. Florida Island, Solomon Islands.

Specimens collected.—**Solomon Islands:** Teneru River, Guadalcanal Island, 8 males (5 alc.), 9 females (7 alc.), 1 subadult, no sex. **Russell Group:** Banika Island, 1 subadult female (alc., skull cleaned).

The skull of the two subadult specimens show the characters ascribed to *P. austini*, the type of which is subadult. Until fully adult specimens showing the characters of *austini* are available, it best be considered a synonym of *woodfordi*. An examination of thirteen *woodfordi* in alcohol did not show any development of the interfemoral membrane medially.

The flight of this bat was more rapid than that of the large fruit bats, which, with its small size identified it on the wing.

Measurements.—Forearm 92.7–99 mm. Skull: greatest length, 42.3–45.4; condylobasal length, 40.3–42.9; palatal length, 21.7–22.6; front of orbit to tip of nasals, 12.6–14.9; interorbital width, 6.4–7.4; intertemporal width, 7.3–8.8; zygomatic width, 24.9–27.9; width of braincase, 18–18.8; upper toothrow, 13.5–14.3; width across canines, 9.1–9.8; across molar^{1}–^{1}, 10.5–11.

Emballonura solomonis Thomas

Emballonura solomonis Thomas, Ann. Mag. Nat. Hist., series 7, vol. 14, p. 200, 1904. Florida Island, Solomon Islands.

Specimens collected.—**Solomon Islands:** Bloody Ridge, inland from Kukum Docks, Guadalcanal Island, 1 male (alc., skull cleaned); Empress Augusta Bay, Bougainville Island, 2 males (alc., 1 skull cleaned).

The forearms measure from 36–36.8 mm. The skulls are too badly broken for measurements to be taken.

Saccolaimus nudicluniatus De Vis

Saccolaimus nudicluniatus De Vis, Ann. Queensland Mus., no. 6, pp. 39–40, 1905; Troughton, Rec. Australian Mus., vol. 14, p. 325, 1925; Tate, Amer. Mus. Nov., no. 1141, p. 3, 1941.

Taphozous granti Thomas, Ann. Mag. Nat. Hist., series 8, vol. 8, p. 378, 1911.

Specimens collected.—**Solomon Islands:** Teneru River, Guadalcanal Island, 2 males, 1 female (alc., 1 skull cleaned).

The forearms of these specimens (67–67.4) are much shorter than the type and cotype of *nudicluniatus* (73.5–75.) and even the type of *granti* (71.), but in all other details they agree exactly with the description given by Troughton. There is a well developed gular sac in the males as suggested by Troughton and the skull shows a strong helmet which might be larger in an older specimen.

Besides the type and cotype from Gowrie Creek, Cardwell, northwest Queensland, and the type of *granti* from Paramau, Mimika River, Dutch New Guinea, Tate has recorded a specimen, apparently a female, from Babinda Creek, North Queensland. These three from the Solomons extend the known range well to the eastward. They were shot on the wing about dusk.

Measurements.—Forearm, 67–67.4 mm.; tail, 22.2–24.6; tibia, 26.–26.5; calcar, 16.6–18.9; 2nd metacarpal, 61.9–64.3; third metacarpal, 66.5–68.5; first phalanx, 25.9–26.6; second phalanx, 25.9–26.9; fourth metacarpal, 46.8–48.8, first phalanx, 19.5–20; second phalanx, 7.1–8.8; fifth metacarpal, 32.8–35.7, first phalanx, 15.7–16.6, second phalanx, 10.4–11; ear from meatus 16.5–17.6. Skull of male: greatest length, 25.5; condylobasal length, 23.6; palatal length, 7.9; rostral width, 10.1; interorbital breadth, 8.7; zygomatic width, 15.8; mastoid width, 13.6; width of braincase, 11.0; upper toothrow, 10.8; width across canines, 5.3; width across molars, 11.0.

Hipposideros cupidus Andersen

Hipposideros cupidus K. Andersen, Ann. Mag. Nat. Hist., series 9, vol. 2, p. 383, 1918. Eaga, Central Division, Papua; Tate, Bull. Amer. Mus. Nat. Hist., vol. 77, p. 364, 1941.

Specimens collected.—**Solomon Islands:** Munda Point, New Georgia Island, 1 male (alc.). **Russell Group:** Banika Island, 1 female (alc., skull cleaned).

Dr. George H. H. Tate of the American Museum of Natural History compared these specimens with his series of *calcaratus* and *cupidus*. He concluded from their size, the position of the notch on the canine, the openings on either side of the pterygoid area, and the length of the toothrow that they were *cupidus*. The forearm of the male measures 50.5 mm and of the female, 53 mm. both slightly large for previous measurements of *cupidus*, but the skull characters agree with those given for that species. Formerly known from New Guinea, these represent a wide extension of range.

Measurements.—Skull: greatest length, 21.9 mm; condylobasal length, 19; rostral width, 5.6; interorbital width, 3.6; zygomatic width, 11; mastoid width, 10.1; width of braincase, 8.5; upper toothrow, from edge of canine to end of crown of m^3, 8; width across canines, 4.7; width across molars, 7.1.

Aselliscus tricuspidatus Temminck

Rhinolophus tricuspidatus Temminck, Monogr. Mamm., vol. 2, p. 20, pl. 32, figs. 11–12, (skull), 1835–41, Amboina.

Aselliscus tricuspidatus, Tate, Amer. Mus. Nov., no. 1140, p. 2, August 20, 1941.

Specimens collected.—**Solomon Islands:** Munda Point, New Georgia Island, 5 males, 3 females (alc., 1 skull cleaned). **Russell Group:** Banika Island, 1 female (alc., skull cleaned).

These are the first records for New Georgia Island and the Russell Group but the bat has been recorded from numerous other islands in the Solomons. The forearms measure 37.7–40 mm and the tibia 12.8–14.6 mm.

Pipistrellus ponceleti Troughton

Pipistrellus ponceleti Troughton, Rec. Australian Mus., vol. 19, p. 351, April 7, 1936. Bougainville Island, Solomon Islands.

Specimens collected.—**Solomon Islands:** mouth of Teneru River, Guadalcanal Island, 1 male (alc., skull cleaned).

This species was recorded from Guadalcanal by Thomas in 1888 as *Vesperugo abramus*.

Measurements.—Forearm, 31.2 mm. Skull: greatest length, 12.3; condylobasal length, 10,7; interorbital width, 3.3; zygomatic width 7.1; mastoid width, 6.4; upper toothrow, 4.1; width across canines, 3.6; width across molars, 5.

Miniopterus macrocneme Revilliod

Miniopterus macrocneme Revilliod, in Sarasin and Roux, Nova Caledonia, A. Zool., vol. 1, pt. 4, p. 360, pl. X, figs. 5, 6, 11 (skull, teeth and tragus), 1914. New Caledonia.

Specimens collected.—**Solomon Islands:** Munda Point, New Georgia Island, 17 males, 18 females (all alc., 5 skulls cleaned). **Russell Group:** Banika Island, 1 female (alc., skull cleaned).

This bat was previously known only from New Caledonia. The present series has been compared with topotypes from New Caledonia. The forearms and tibia measure 41.3–44.5 mm in males and 42.0–44.0 mm in females. Skull: greatest length, 14.1–14.5; condylobasal length, 12.5–12.7; interorbital width, 3.4–3.6; zygomatic width, 7.2 + – 7.6 + (all broken); width of braincase, 7–7.2; upper toothrow c-m^3, 5.3–5.5; width across canines, 3.9–4.2; across molars, 5.4–5.8; height of skull, 6.8–7.

Chicago Natural History Museum, Chicago, Illinois.

SEX RATIO AND WEIGHTS OF SOUTHWESTERN LAKE ERIE MUSKRATS

By John M. Anderson

Sex ratio and weight studies of the muskrat (*Ondatra z. zibethicus*) made in nearby states, such as Minnesota, Iowa, Pennsylvania, and New York, have left a gap in the central region which this Ohio report is designed partially to fill.

DESCRIPTION OF THE AREA

At the western tip of Sandusky Bay, off southwestern Lake Erie, the Sandusky River and Muddy Creek unite. The mouths of these two streams form a smaller bay, about three miles long and half a mile wide. The small bay and the marsh surrounding it comprise the shooting grounds of the Winous Point Duck Club a total area of 4,400 acres, 2,800 acres of which are marsh land. The emergent vegetation is primarily narrow-leaved cattail (*Typha angustifolia*), which on the drier sites is replaced by river bulrush (*Scirpus fluviatilis*), blue-joint grass (*Calamogrostic canadensis*), cane (*Phragmites*), sedge (*Carex* sp.) and millet (*Echinochloa* sp.).

SEX RATIO

A contract that permitted trappers to take animals home for skinning generally prevented handling of unskinned animals, and since the carcasses were usually sold at ten or fifteen cents apiece, very few were available for study purposes. Sex ratios, however, are easily determined from pelts, and were usually gotten in this manner. A total of 10,191 muskrats were trapped between December 10, 1945, and March 15, 1946, and the sex determined on 5,759. There were 3,184 males (55.2%) and 2,575 females; a sex ratio of 124 to 100; a statistically significant departure from a 50–50 ratio. The data from each of ten trapping units were divided into two-week periods (see Table 1). This preponderance of males was maintained throughout the trapping season on all units except one, on which the ratio was 50-50; on the others, it ranged from 52 to 60% males.

This ratio of 55.2% males is in general agreement with other workers in north central states. McCann (1944) in Minnesota found 55% males; Buss (1941)

in Wisconsin, 69%; Errington (1939) in Iowa, 54.9%; Frison (1941) in Illinois, 58.8%; Grimm (1941) in western Pennsylvania, 58.8%; Dozier (1945) in central New York, 55%. The 55.2% males in March, however, is in disagreement with the common belief among local trappers that a preponderance of females is taken during this month. Dozier (1945), in Maryland, also found a belief among local trappers that a preponderance of females would be taken in March, but such was not the case.

WEIGHTS

Before discussing weights, it should be mentioned that there has been a marked decline in the acreage of cattail on the marsh in the past five years. This decline varies from 65 to 83% on various units. Areas 20 acres in size formerly covered by cattail, but now barren of all plants, are not uncommon. Narrow-leaved

TABLE 1.—*Sex ratio of Winous Point Club muskrats, trapped December 10, 1945, to March 15, 1946*

UNIT NO.	DEC. 10–31		JAN. 1–15		JAN. 16–31		FEB. 1–15		FEB. 16–28		MAR. 1–15		TOTAL	PER CENT MALES
	M	F	M	F	M	F	M	F	M	F	M	F		
1	108	100	78	75	77	65			39	31	17	16	606	52.6
2	16	11	2	5	3	0	22	13	3	2	72	49	200	59.0
3	46	38	33	26	12	15	16	21	13	18	36	26	300	52.0
4	12	9	2	1			7	5	25	10	55	42	168	60.1
5									17	7	132	145	301	49.5
6	18	5							56	44	69	68	260	55.0
7			10	8			4	2			8	7	39	57.8
8	106	111	70	58	59	52	82	67	27	19	208	127	986	55.9
9	215	184	35	25	144	112	20	4	326	285	434	343	2,127	55.2
10			49	42	108	76			39	21	38	39	422	57.8
11			8	7					21	9	177	129	350	58.9
Totals....	979		534		723		263		1,014		2,246		5,759	55.2

cattail is the prime muskrat food plant in this region. The effect of this decline on the average weight of muskrats is not known. In the future, if and when the cattail returns to its former abundance, it should be possible to measure its effect, both on density of population and average weight.

In general, there was but little fat on the Winous Point muskrats. Dozier (1945) emphasizes the large amount of fat on muskrats trapped on the lower pool of the Montezuma National Wildlife Refuge in New York in contrast to those in the upper pool. His description and photographs of the upper pool animals apply very well to the Winous Point muskrats.

Weights on 1,146 muskrats, representing the catch on four trapping units on the Winous Point marsh from March 1 to March 15 give the following results:

1. A total of 652 males ranged from 15½ ounces to 3 pounds, 11 ounces, the average being 2.40 pounds.

2. A total of 494 females ranged from 1 pound to 3 pounds, 5 ounces, averaging 2.26 pounds.
3. The combined average was 2.33 pounds.
4. Males averaged from 2 to 3 ounces heavier than females on three units. On the fourth, however, females exceeded males in average weight by ½ ounce (Table 2). It is interesting to note that on this particular unit the sex ratio was equal. In other words, on the only unit where females equalled males in number, they also equalled them in weight. Whether this is due to differential migration, selective trapping, or other factors is not known. This unit, incidentally, was not trapped before February 16, whereas, trapping on the other units began December 10.
5. As in the case of sex ratio, the weight data agree closely with other workers in the region. Schoonmaker (1929) in New York got an average weight of 2.34 pounds; Grimm in Pennsylvania, 2.36; Errington in Iowa, 2.36; Buss in Wisconsin, 2.27; Dozier in Maryland, 2.25.

TABLE 2.—*Weights (in pounds) of some Winous Point Club muskrats, trapped March 1–15, 1946*

UNIT NO.	MALES		FEMALES		COMBINED	
	No.	Ave. Wt.	No.	Ave. Wt.	No.	Ave. Wt.
2	84	2.31	54	2.12	138	2.23
5	132	2.25	144	2.28	276	2.27
8	171	2.50	101	2.31	272	2.43
9	265	2.44	195	2.25	460	2.35
Totals.....	652	2.40	494	2.26	1,146	2.33

6. The average weight of 2.33 pounds is in marked contrast, however, to the results of Dozier on the Montezuma National Wildlife Refuge in central New York where he found an average of 3.5 pounds, the males averaging 3.6 pounds and the females 3.3 pounds.

When segregated by 2-ounce groups, the 2 pound-8 ounce to 2 pound-10 ounce group contained the largest number of males. The 2 pound to 2 pound-2 ounce group contained the largest number of females.

Errington (*op. cit.*) states, "Limited data indicate that, by the end of the first year, muskrats reach average weights close to 1,100 grams" (2.45 pounds). If the same be true of Ohio muskrats in spring, then it would seem safe to assume that most of the animals weighing less than 2 pounds were less than a year old. Animals in this group comprised 22% of the total. The sex ratio in this lightest weight group was 87 males to 100 females. Animals weighing more than 2.75 pounds, most of which might be considered adults, comprised 18% of the total. The sex ratio in this heaviest weight group was 200 males to 100 females. The middle group, weighing from 2 pounds to 2.75 pounds, comprised 60% of the total, with a sex ratio of 136 males to 100 females. This middle group undoubtedly contained an over-lap of both age classes.

From the fact that in animals weighing less than 2 pounds the females exceeded the males in number by a ratio of 100 to 87, we may draw the inferences that in the juvenile population the females outnumber the males; or, that trapping is selective of juvenile females; or, that juvenile males gain weight faster than juvenile females. The last inference seems most logical since the over-all sex ratio contains 124 males to 100 females, and males also averaged 2 to 3 ounces heavier. Furthermore, Errington (1939) states that his Round Lake data for subadult sizes of November and December "point to a decidedly slower growth for the females." It would seem, then, that a larger proportion of the juvenile

TABLE 3.—*Frequency distribution of muskrat weights by 2-ounce classes*

WEIGHT (Lbs.—Oz.)	MALES	FEMALES	TOTAL	SEX RATIO
1– 0	1	3	4	
1– 2	1	3	4	
1– 4	10	10	20	
1– 6	5	14	19	87 M / 100 F
1– 8	10	16	26	
1–10	26	18	44	
1–12	38	35	73	
1–14	25	35	60	
2– 0	56	60	116	
2– 2	61	54	115	
2– 4	68	51	119	
2– 6	60	43	103	136 M / 100 F
2– 8	79	43	122	
2–10	70	38	108	
2–12	40	31	71	
2–14	34	16	50	
3– 0	28	13	41	
3– 2	16	8	24	
3– 4	11	3	14	200 M / 100 F
3– 6	6	0	6	
3– 8	5	0	5	
3–10	2	0	2	
Totals.....	652	494	1,146	

males in the Winous Point marsh have reached the 2 pound class by March 1 than is the case with females, substantiating Errington's observation.

SUMMARY

1. A total of 2,800 acres on the Winous Point marsh were trapped by eleven trappers from December 10, 1945 to March 15, 1946. The yield was 10,191 muskrats. The sex ratio, determined on 5,759, was 3,184 males, 2,575 females, or, 124 males to 100 females.

2. Weights were taken on 1,146 muskrats caught between March 1 and March 15, 1946. Of these, 652 males averaged 2.40 pounds, 494 females averaged 2.26 pounds.

3. Arranged by 2-ounce groups, the 2 pound-8 ounce to 2 pound-10 ounce group contained the largest number of males. The 2 pound to 2 pound-2 ounce group contained the largest number of females.

4. The sex ratio of muskrats weighing less than 2 pounds was 87 males to 100 females; of animals over 2.75 pounds, 200 males to 100 females; in the group of 2 pounds to 2.75 pounds, 136 males to 100 females.

LITERATURE CITED

BUSS, IRVEN O. 1941. Sex ratios and weights of muskrats from Wisconsin. Jour. Mamm. vol. 22, pp. 403–406.

DOZIER, H. L. 1945. Sex ratio and weights of muskrats from the Montezuma National Wildlife Refuge. Jour. Wildl. Mgt., vol. 9, pp. 232–237.

ERRINGTON, PAUL L. 1939. Observations on young muskrats in Iowa. Jour. Mamm., vol. 20, pp. 465–478.

FRISON, T. H., *et al.* 1941. Muskrat study. Wildlife Research News, Ill. Nat. Hist. Survey, May, pp. 11–12.

GRIMM, WILLIAM C. 1941. The muskrat in Northwestern Pennsylvania. Pennsylvania Game News, vol. 12, pp. 6–7.

MCCANN, LESTER J. 1944. Notes on growth, sex and age ratios, and suggested management of Minnesota muskrats. Jour. Mamm., vol. 25, pp. 59–63.

SCHOONMAKER, W. J. 1929. Weights of some New York mammals. Jour. Mamm., vol. 10, p. 149.

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PREPARATION AND PRESERVATION OF THE BACULUM OF MAMMALS

BY CHARLES E. FRILEY, JR.

Numerous studies have been made recently on the morphology of the mammalian baculum with the objective of using this structure in taxonomic work (Burt, 1936), but little has been reported in these papers concerning the techniques of preparation and preservation of the materials. Hamilton (1946) outlines briefly his methods in preparing the materials for study. The following technique has been used with excellent results on about 1,000 bacula in the Division of Mammals, Museum of Zoology, University of Michigan, during the past year. While the technique is designed primarily for use with field-prepared museum skins, it may be easily adapted for use with alcoholics and laboratory prepared specimens.

After completing the ventral incision, preparatory to skinning the specimen, the glans penis is cut at its junction with the body leaving the distal portion attached to the belly skin. In sewing up the nearly finished skin, the everted glans penis is placed outside the incision. The completed skin with penis attached may then be pinned and dried in the usual manner. The pinning process will force the glans penis against the ventral surface of the specimen where it will dry in place.

To remove the baculum in the laboratory, cut the glans penis from the speci-

men as close to the skin as possible. Some difficulty has been experienced, especially with the longer bacula of *Peromyscus truei* and *P. mexicanus*, from failure of the collector to pull the glans penis far enough to prevent cutting the bone. Materials from alcoholics and laboratory prepared specimens are not dried but go directly into the clearing agent as indicated below.

A series of small, stoppered, glass vials is used for the solutions. A label of durable paper, with number written in pencil, accompanies each specimen through the entire process. The glans penis is placed in a 1N or 2N solution of KOH for clearing and softening of the tissues. Normal time in this solution is about one hour for the smaller bacula of *Baiomys*, *Peromyscus*, and *Microtus*; about two hours for *Neotoma* and *Sigmodon* sizes; about four hours for Sciuridae

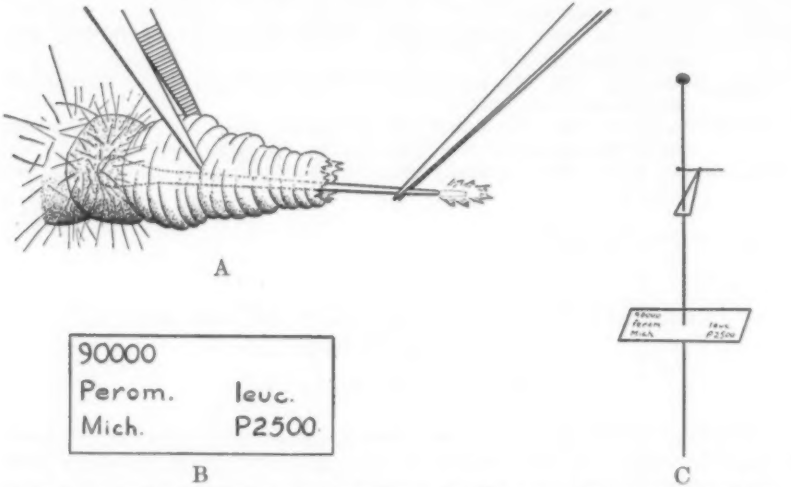

FIG. 1. A method of removing os penis from enclosing tissues; B, sample of lable; C, method of mounting dried bacula for storage.

and Mustelidae; and eight to twelve hours for *Canis*, *Vulpes*, and *Ursus*. For bacula of juveniles, the time is cut approximately in half.

The adhering tissues are removed from the baculum as soon as the glans penis is taken from the KOH solution. Equipment for this phase of preparation includes a small binocular microscope, a shallow ($\frac{1}{4}$ inch deep) dish about two inches in diameter, two 4 or 5 inch sharp-pointed forceps, and a very small scalpel. A large needle, heated, flattened, and then sharpened on one edge and set into a handle, works well as a scalpel. The bacula of some forms (*Peromyscus* and *Reithrodontomys*) may be slipped completely out of the tissues enclosing them (fig. 1, a). If the tissues remain attached to the broad basal end of the bone, they may be severed with the scalpel. In removing *Microtus*, *Sigmodon*, and *Neotoma* bacula from the surrounding tissues, it is best to cut the tissues com-

pletely up one side with either scalpel or scissors. The main shaft and attached cartilage and processes are thus exposed and teasing the tissues away may proceed with certainty. This latter method is generally applicable with Sciuridae and Mustelidae, although much scraping and tissue cutting is required with the sciurids. The cleaned baculum, with its attached processes and cartilage is immersed momentarily in 5% acetic acid then in water to return it to a chemically neutral condition. If the baculum is to be stained, it is now placed in Haines' Solution (2000 cc of 2% sol. KOH to 0.1 gm Alizarin Red S) for about four days. It is then removed to glycerin for preservation.

For the preservation of bacula in a dried condition, the method used in mounting insects is closely followed. A small cellulose acetate triangle (cut from an X-ray film) is mounted on an insect pin about one-third of the way down from the head. The baculum is placed in a drop of Duco cement (no. 5758) on the tip of the triangle and allowed to dry in place. A label, about 8 x 18 mm (fig. 1, b) with the baculum number and the abbreviated specific name and locality, is affixed on the pin about one-third of the way up from the point (fig. 1, c). The bacula are then filed by species and by states in 3 by 4½ inch covered boxes with cork-insert bottoms. For bacula up to and including those the size of squirrels, it is customary to file 25 in one box; for larger bacula, *Mustela*, etc., 20 are filed in a box. In the case of bacula the size of *Canis*, *Lutra*, *Procyon*, and *Vulpes* the pertinent data are written with India ink on the bones which are filed unmounted.

The method outlined above has been successfully used on bacula up to one inch in length. No particular advantage has been found in using this method on the larger specimens. A dermestid beetle colony will clean them satisfactorily since there are no small processes subject to loss. The use of dermestids for cleaning small bacula has been tried and found to have the following disadvantages: (1) Cartilagenous material is destroyed; (2) bony processes surrounded by cartilage may be lost in the debris left by the beetles; (3) uncalcified portions of the shaft may be destroyed.

LITERATURE CITED

Burt, W. H. 1936. A study of the baculum in the genera Perognathus and Dipodomys. Jour. Mamm., vol. 17, no. 2, pp. 145–156.

Hamilton, W. J., Jr. 1946. A study of the baculum in some North American Microtinae. Jour. Mamm., vol. 27, no. 4, pp. 378–387.

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GENERAL NOTES

THE CANADIAN PORCUPINE AGAIN A HIGHWAY MORTALITY VICTIM

While driving south in the Adirondacks, near noon on September 22, 1946, I found a dead female Canada porcupine (*Erithizon d. dorsatum*). It was lying at the edge of State Highway 10, in Hamilton Co., New York, about 18 miles south of the town of Tupper Lake. Swampy areas and woods abound on both sides of this much traveled elevated paved roadway. The morning had been dark, cloudy and fairly warm after the rain of the preceding evening, yet the animal and the stones beneath it were dry and free from insects. Evidently the porcupine was a highway mortality victim of the preceding twelve hours. The nature of several of the bruises indicated that the individual had been struck hard on one side of the body.

Considerable blood was found in the bloated abdominal cavity when it was opened. The well filled stomach and intestines, especially the duodenum, contained smooth well masticated greenish colored food which was in a semi-solid smooth compact mass. The sex organs appeared normal and the mammary glands were undeveloped. All the teeth were intact and in good condition except the incisors which were slightly worn down and ragged. The animal weighed 22.5 pounds.

In the skull, now specimen no. 6503 in the New York State Museum, the cranial sutures are well marked and quite distinct; there is no tendency to fusion evident, except between the frontal and parietal bones.

It appears to me that since the cranial sutures showed only a slight tendency to fuse, the mammary glands were undeveloped and it had both greater weight and a longer tail (vertebrae measurement) than usual, this highway mortality victim was at least entering its third year of age when it was killed (see Jour. Mamm., vol. 9, no. 4, pp. 300–308, 1928).—LILLIAN C. STONER, *New York State Museum, Albany, New York.*

RESORPTION OF EMBRYOS IN THE MUSKRAT

Breeding experiments with muskrats (*Ondatra zibethicus macrodon*) at the U. S. Fur Animal Field Station in 1938 and 1939 were quite discouraging. The handling methods and type of pens used were largely responsible for this. Even so, some actual matings were observed in 18 foot square marsh inclosures, and when the females were caught and transferred to small holding pens to check accurately the gestation period, these bred females failed to produce litters. Handling and disturbing female muskrats during the breeding period and after copulation was found to be detrimental to conception and reproduction.

A few females had conceived, however, for they increased noticeably in size and weight. The condition of the mammae also indicated pregnancy but no young were born. Such a condition suggested the possibility of embryo resorption. This appears to be rare, however, in the muskrat for in examining more than 15,000 female carcasses taken on the Blackwater National Wildlife Refuge during the trapping seasons of 1938–47 and several hundred more trapped experimentally during April to November in 1940 only one instance of resorption was observed. All embryos present appeared normal in development and the average number of placental scars or sites corresponded with the average litter size for the race *macrodon*. The single exception was a 2 lb. 6 oz. black-and-tan female (#685), trapped March 8, 1945, on the Stevens marsh of the Refuge. This female contained two embryos of varying size and abnormal grayish color, located singly in each of the uterine horns. Dissection by Dr. Robert K. Enders and the writer showed them to be unquestionably in the process of being resorbed.—HERBERT L. DOZIER, *U. S. Fur Animal Field Station, Cambridge, Maryland.*

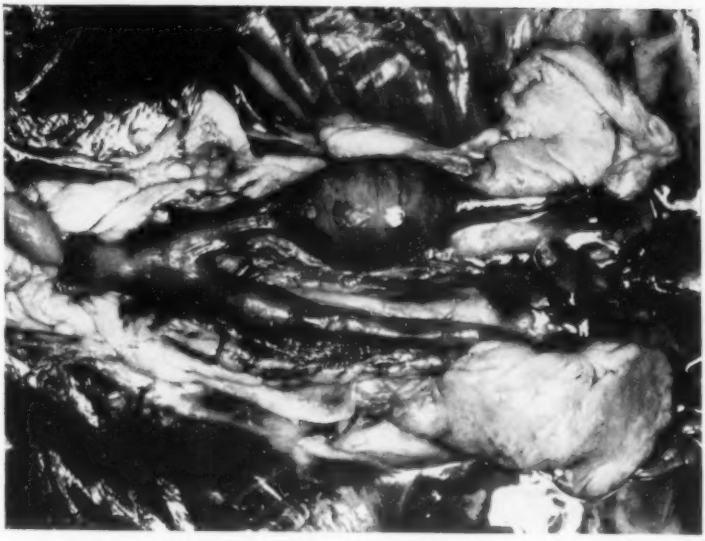


PLATE 1

Reproductive tract of female muskrat, showing embryos in the process of being resorbed.

Natural size

AN EXAMPLE OF "PRELACTEAL INCISORS" IN ADVANCED POUCH YOUNG OF MACROPUS

When studying Macropodidae recently at the U. S. National Museum, Washington, D.C., I found a young specimen of *Macropus robustus reginae* at the stage in which $p\frac{3}{3}$ and the molariform $dp\frac{4}{4}$ were already in place, with $m\frac{1-2}{1-2}$ visible within their alveoli. T is specimen differed from numerous other pouch young examined from the fact that it possessed a pair of minute incisiform teeth situated on the premaxillae external to the posterior halves of the very large just erupting third incisors (see plate). Doctors Remington Kellogg and David H. Johnson at my suggestion have kindly had this skull photographed so that it may be reproduced with the present note.

Woodward (Proc. Zool. Soc. London, 1893, pp. 450–473), using cleared material, first drew attention to the presence of "prelacteal" incisors in marsupials. This investigation was extended by Dependorf (Semons Zool. Forsch., 1898, vol. 3, pp. 243–402) and others, the latest work being apparently that of Engelhardt (Gegenbaurs morph. Jahrb., 1932, vol. 71, pp. 77–94) who worked on the hare-wallaby *Aepyprymnus*. Woodward, using *Aepyprymnus*, *Petrogale*, *Thylogale*, and *M. canguru* (= *giganteus*), recognized five "prelacteal" incisors in the upper jaw. Dependorf and Engelhardt found six in *Aepyprymnus*. These three authors differed from one another rather widely in their interpretations of the dental series to which such teeth belonged.

The teeth which are now depicted are wholly unlike the canines of the quite numerous genera of Macropodinae which still retain canines. Macropod canines, though reduced

and often extremely slender, or inclined, are invariably caniniform, while the present teeth are not. Moreover, macropod canines are invariably located in the maxillo-premaxillary sutures or behind them, whereas the present teeth stand well within the premaxillae.

Since making the present discovery I have found a specimen of *Macropus canguru*, A.M.N.H.No.65017, in which also a pair of these teeth is preserved. It seems likely that such minute teeth may often still be present in the nursing young of *Macropus* but become

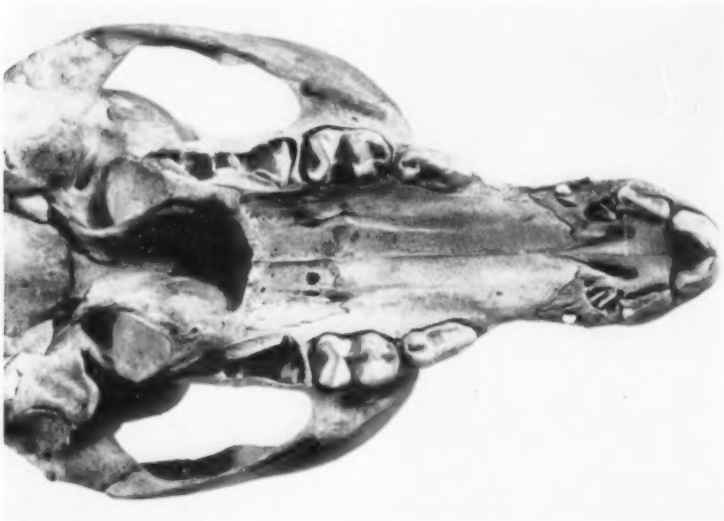


PLATE 1

Ventral view of skull of pouch young of *Macropus robustus reginae* (U. S. N. M. No. 238324, ♀), showing "prelacteal" teeth

lost during the cleaning of the skulls.—G. H. H. TATE, *American Museum of Natural History, New York City, New York.*

BODY TEMPERATURE DATA FOR THE COTTONTAIL RABBIT

Because the literature on the body temperatures of even the common larger wild mammals is decidedly limited, the following data is presented for the Mearn's cottontail (*Sylvilagus floridanus mearnsii*). They were collected in November 1946 on the Ohio State University campus, Columbus, Ohio, incidental to other studies of wild rabbits. An ordinary clinical thermometer was applied rectally to tagged, live-trapped specimens mostly of known ages. "Adults" were more than one year old. All specimens were studied indoors at a room temperature of about 70°F. They were partly covered by a cloth sack while their temperatures were taken. The thermometers were held in the rectum for at least two minutes after the mercury reached its maximum point.

SPECIMEN NO.	SEX	AGE	WEIGHT	RESPIRATION RATE	TEMPERATURE
53	Female	Immature	906 g.	—	101.9° F.
53	"	"	955	120/min.	101.8
76	"	"	1144	—	102.6
81	"	"	1051	—	102.4
92	"	"	959	160	101.5
203	"	"	1101	—	98.0
203	"	"	1101	—	102.5
203	"	"	1052	—	97.7
207	"	"	1100	232	101.9
83	Male	"	872	—	102.5
83	"	"	849	184	102.5
90	"	"	1075	230	102.4
95	"	"	1126	200	101.6
99	"	"	939	132	102.4
213	"	"	1300	204	102.4
220	"	"	1103	76	100.9
206	Female	Adult	1346	—	105.0
215	"	"	1496	100	99.6

The average of the above 18 temperature readings was 101.6° F. The extremes were 97.7° and 105.0° F. There seemed to be no correlation between temperature and sex, age, weight or respiratory rate. The seven records for males, however, showed much less variability (100.9°–102.5°(102.1°)) than the eleven for females (97.7°–105.0° (101.4°)). The effects of handling could not be determined accurately with the apparatus at hand but it was obvious that a rise in temperature occurred with increased fear on the part of the rabbit. Two records for specimen 203, for example, were taken only a few minutes apart. Although the mercury remained steady at 98.0° for several minutes, unintentional stimulation of the animal caused a quick rise to 102.5°. It is not believed that the average temperature given here is the normal body temperature for the species. The latter figure will probably be found to average somewhat lower than 101.6° F. and to vary, probably largely within the extremes given here, with the activity and environment of the animals studied.—GEORGE A. PETRIDES, *Cooperative Wildlife Research Unit, Ohio State University, Columbus, Ohio.*

AN EMIGRATION OF SQUIRRELS IN WISCONSIN

There was an emigration of squirrels in northwestern Wisconsin in the autumn of 1946. Unfortunately, I did not learn of the movement while it was in progress so that the information on it has been obtained largely through a questionnaire sent mainly to the wardens of the Wisconsin Conservation Department.

Both gray (*Sciurus carolinensis*) and fox (*Sciurus niger*) squirrels were involved. Participation by the fox squirrel is of special interest since authentic cases of mass movement of this species are rare. At Osceola there were a few fox but mainly gray squirrels, a very few being the black phase. Fox squirrels predominated at Hudson. Many were picked up in the middle of the St. Croix River, unable to reach land. At Hudson they invaded the corn fields of the prairie and up to the middle of October were still present, "several miles from timber." It was estimated that at Ellsworth the fox squirrel outnumbered the gray 15 to 1. Duck hunters found fox squirrels swimming in the middle of Lake Menomin, Dunn County. This species also swam Lake Eau Galle in the same county and two were caught in gill nets and drowned. Warden Werner Radke reported seeing approximately 50 fox squirrels while traveling a mile of road in the towns of Albion and Springfield, western Jackson County. They were moving to the southwest.

Both species, in general, moved at random. In certain localities both moved in opposite directions, in some east or west, and in others in all directions. The case was put succinctly by Warden J. W. Jonas, of Ellsworth: "This movement was very peculiar from the standpoint of wildlife migration. In a few instances I had the opportunity to observe their movements and it seemed that no two animals were headed in the same direction. They were crossing the highways and swimming the rivers. Many of them were killed by the traffic and many drowned while swimming the Mississippi and St. Croix rivers. Very few people were aware of any such movement until numbers of them were found dead along the river banks. The movement was most noticeable in the entire western half of Pierce County and it seemed that the nearer one came to the Mississippi and St. Croix rivers, the more intense the population became."

In Polk, St. Croix, and Pierce counties the majority of the squirrels moved westward while in Pepin, Buffalo, and Trempealeau counties the main trend was eastward. Only gray squirrels were moving at Sarona, Washburn County. They travelled in all directions and were found dead on the highways within a radius of 20 miles. At Alma, fox and gray squirrels swam westward across the Mississippi and attempted to cross where the river was one-half of a mile wide.

The movement began the middle of August. On August 13, Charles P. Ecelberger, Supervisor of Commercial Fisheries, found both species swimming across Lake Pepin, a widening of the Mississippi. On that day he walked three miles along the Wisconsin shore and buried 47 drowned squirrels. Fewer dead squirrels were observed on the Minnesota side. The movement continued until the third week in September, after which time only three dead squirrels were found and none seen swimming. At Ellsworth the emigration was obvious the week of September 8 and continued up to the week of September 22. Another observer in the same county stated that it was heaviest between September 12 and 18. The movements at Sarona and Fountain City lasted from September 1 to October 1.

The emigration was pronounced from Fountain City to the upper end of Lake St. Croix, and barely noticeable from this point northward. The entrance of gray squirrels into the city of Superior provoked newspaper comment since this species is relatively rare in that locality. The front of the movement accordingly covered a distance of approximately 180 miles and extended east of the Mississippi and St. Croix rivers about 60 miles.

No satisfactory data on the number of squirrels moving could be obtained. Robert A. Bailey estimated that there were 50 gray squirrels to the square mile at Sarona and that about one-half were on the move. Some of the Supervisors of Commercial Fisheries reported that "hundreds" drowned in attempting to cross the rivers. The number of squirrels participating in the shuffle ran into the thousands. However, the movement was not spectacular since present conditions do not permit building up the enormous populations of pioneer times.

The movement was caused by a shortage of acorns. All observers were in agreement on this point. The previous fall there was a good crop of acorns and a fair to high squirrel population. This year the acorn crop was exceptionally poor, varying from none to 15 percent of a normal crop. A large crop of hazelnuts and a medium one of walnuts and hickory nuts at Fountain City was taken by the squirrels in a short time. At Osceola there were no butternuts or hazelnuts. Forest Supervisor, H. T. J. Cramer, reported that the yield of acorns in Jackson, Juneau, Adams, and Waushara counties varied from 5 to 15 percent of normal. The central counties had a "heavy" population of squirrels and the acorns were practically exhausted by October 1.

In the coniferous belt there was an abundant crop of seeds of the white pine, while the yield by the jack pine was medium, and by the Norway poor. The gray squirrels were using these cones, but there is ample evidence that they cannot subsist on coniferous seeds alone. The diet must be supplemented with acorns, corn, or the seeds of the hard maple. As a last resort they will eat the cambium layer of the latter tree. In the spring of 1946, at Trout Lake, I observed young trees that had been denuded of bark over large areas and there had been complaints of the damage by owners of cottages.

The emigrating squirrels were generally in good condition. The gray squirrels that were eating pumpkins in the gardens at St. Croix Falls appeared to be thin. On October 13, Warden Louis H. Giesen, of Fountain City, arrested a hunter who had in illegal possession 12 gray and 2 fox squirrels that had been shot between 8.30 and 11.00 a.m. These squirrels were in "good shape." This is understandable since they continued moving until corn fields were reached. The damage to corn in some sections was high. At Lake Eau Galle there were corn fields and oak forests on both sides of the lake yet the fox squirrels swam eastward.—A. W. SCHORGER, *168 N. Prospect Ave., Madison, Wisconsin.*

NOTE ON LIGHT-COLORED BLARINA

There has been much written about partial albinism and albinism in shrews, especially *Blarina*. However, I feel that the following account warrants recording.

During the summer of 1946, Neil Richmond and I were trapping in Butler County, Pennsylvania, for the Pennsylvania Mammal Survey; during the fall, in Beaver County. While in Butler County we trapped three partially white *Blarina*, one with two small white spots on the venter, one with a white band on the tail, and one with a white bar on the left side. The last animal was trapped on August 20. On Agust 24 an entirely "blond" *Blarina* was caught in the same locality. The blond animal had a silvery cream pelage, a tail just slightly lighter than normal, nose and ears dusky, teeth normally pigmented, and feet no lighter than normal for many of the local *Blarina*.

In October we trapped a *Blarina* midway in color between the above "blond" shrew and the normal dark coloration. This shrew's entire body was a silvery lead-grey and was conspicuously lighter than normal even when seen in the trap from a fair distance.

These animals seem to suggest a wide range over which the quantity of dark pigment varies, and I suspect that in time a graduated series of animals varying from pure "blond"[1] to the normal dark color could be assembled, as well as all degrees of white spotting. We were unable to determine whether the incidence of white spotted *Blarina* was higher in the locality where the "blond" animal was trapped than in other localities. These specimens are at present in the Carnegie Museum, Pittsburgh.—JOHN J. CHRISTIAN, *312 10th St., Franklin, Pennsylvania.*

AN UNUSUAL MELANISTIC SQUIRREL

On September 11, 1945, Dr. A. C. Hodson of the University of Minnesota entomology department brought to the Minnesota Museum of Natural History a melanistic gray squirrel, *Sciurus carolinensis*, taken near Brainerd, Minnesota. This striking specimen (MMNH, No. 1884) was glistening black all over except for a large tuft of pure white hairs on the tip of the tail. The caudal vertebrae measured but 95 mm in length and terminated in a rounded cartilaginous knob which indicated that the member had, beyond doubt, been amputated and the hair growing from the renewed tissue at the point of injury was pure white and slightly longer than adjacent black hairs. While skinning the specimen I noticed that in addition to the white tip on the tail, there was a tiny tuft of pure white hair growing from the ventral surface of the tail about half way out from the body. A careful examination of the vertebrae at this point revealed what appeared to be a rudimentary tail consisting of 2 or 3 small, linear bones extending backward along the ventral surface of the tail in the region of the 3rd, 4th and 5th caudal vertebrae. The tiny tuft of white hairs coincided in position with the terminal one of these bones and presumably grew from its tip although the skin had been removed before the presence of the rudimentary tail was detected. The tail at this point did not show any evidence of injury although it is possible an injury might have been associated with its development. The complete tail in the flesh with the rudimentary bones in place was preserved for a time in formalin and later dried and is at present attached to the specimen.

Mr. D. Dwight Davis, Curator of Anatomy, Chicago Natural History Museum, recently called my attention to an article in the *Journal of Mammalogy* (vol. 4, no. 1, pp. 56–58, 1923) by A. Brazier Howell describing an almost identical anomaly in a pocket mouse

(*Perognathus penicillatus angustirostris*) and a similar one in a kangaroo rat (*Dipodomys merriami simiolus*), both from California. In these specimens the replaced hairs are white as well as somewhat longer and coarser than the original hairs. In calling attention to these specimens, Howell discusses at some length a theoretical basis for such odd growths, but the presence of these in a squirrel seems rather damaging to his theory. It might be thought that such factors as govern the development of the differing pelages in such animals as the snowshoe rabbit might be concerned here but Severaid's conclusion (Jour. Mamm., vol. 26, pp. 41–63, 1945) that after plucking "the new hair so grown always has the same characteristics as the rest of the pelage. . . ." seems to oppose such a contention. Experiments with Himalayan rabbits (white bodies and black appendages) bearing on the nature of partial albinism might shed light on the condition of this specimen. When patches on the bodies of baby Himalayan rabbits were shaved and the animals kept at 5° to 9° C., the new fur grew in black. Also baby rabbits removed to a temperature of 17° C. for ten minutes on two successive days or if sponged with cold water, the fur developed black. Obviously a delicate balance exists with resepct to temperature between color bases and color developers in certain conditions of albinism and melanism. Since the regenerated hair grown on the injured tail may well have grown under temperature conditions other than those under which the original hair developed, temperature may have been the determining factor in producing this strikingly colored animal.—W. J. Breckenridge, *Minnesota. Museum of Natural History, University of Minnesota, Minneapolis, Minnesota.*

HOMING OF FLYING SQUIRRELS

The homing instinct of mammals is somewhat less well known than that of birds. The following incident illustrates the homing ability of a flying squirrel (*Glaucomys v. volans*).

Dr. J. T. Curtis who lives ½ mile from the University of Wisconsin Arboretum in Madison, Wisconsin, trapped two flying squirrels in his attic on January 9. They were taken to the Arboretum and released in the hopes that the refuge might gain two squirrels and the Curtis household be rid of nightly disturbances. The trapping, however, continued fruitful and three more were caught, two of which subsequently died in the trap, the third released in the refuge. On January 21, two squirrels were again captured (both in the same trap). With trapping disgustingly successful, Dr. Curtis suggested that our squirrels were returning from the release points. While this did not seem likely, I marked these two squirrels, one male, one female, by clipping the inside toe on the right hind foot. They were released a half mile inside the Arboretum boundary in an oak grown fence row adjacent to a 60 acre woodlot. Six days later the toe-clipped female was again caught in the attic trap. The clipped toe was healing beautifully and the animal showed no ill effects from the toe clipping, the trapping or the journey home. The morning of the release the temperature was −3° F. and there was about two inches of snow on the ground. On only one day in the week that followed was the temperature above freezing. The return to the point of capture was one mile in a straight line. If we assume that the animals traveled through the trees, the distance would then be 1¾ miles and at one point it would have had to cross 250 yards of treeless terrain. If a straight line course was pursued, the treeless distance would be about ¼ mile.

This is an interesting fact, inasmuch as Howell in his revision of the American Flying Squirrels (N. Am. Fauna, no. 44), states: "Flying Squirrels are almost exclusively arboreal, seldom descending to the ground and apparently never running for any distance on its surface."—R. A. McCabe, *University of Wisconsin Arboretum, Madison, Wisconsin.*

A CASE OF SIX CUBS IN THE COMMON BLACK BEAR

In May 1945 (Jour. Mamm., vol. 26, no. 2), I put on record several authentic examples of quadruplet cubs among black bears (*Euarctos americanus*), and a single instance of quintuplets. Since then, in addition to two more lots of quadruplets born in Jasper Park, Alberta, an apparently valid case of a sextet has come to my notice. I am indebted to Mr. P. B. Reader, Provincial Game Guardian at the Pas, Manitoba, for kindly supplying

me with the details which have reached me in the form of an attested statement signed by the trapper, Mr. Tom Wykstandt, who killed the bear and cubs.

His statement is brief and the facts are as follows: On May 15, 1946, Mr. Wykstandt encountered a female black bear which he shot. She was thin, with an estimated weight of 225 lbs. Accompanying her were six small cubs, all black and all of similar size. These were also killed. The mother had six teats in full milk. No other female bears were known to be in the neighborhood, although an adult male was trapped within a few days at the same spot. Mr. Wykstandt has been a trapper in northern Manitoba for 30 years, is thoroughly familiar with bears, and considers the evidence conclusive that all six cubs were the progeny of this one female. From the facts of the case it would seem that this conclusion is sufficiently justified.—Wm. Rowan, *University of Alberta, Edmonton, Canada.*

PECULIAR BEHAVIOR OF A RED FOX

On March 18, 1947, midway between Flemington and Sommerville, New Jersey, I observed a red fox (*Vulpes fulva*) on the opposite side of the highway standing by a prone object on the pavement. The fox looked up as I went past but did no more than step off the pavement onto the shoulder. I stopped and turned around to investigate, parking the car with the front headlight no more than ten feet from the fox. Leaving the headlights on for visability I stepped from the car, spoke to the fox as I would a dog, and walked up and patted him on the head, scratched his ears a little and then looked down to discover that the prone object he was tending was another fox, apparently killed by a passing car. The live fox stepped away from me and began licking the corpse. I observed that the surviving fox was a male and assumed that the dead one was a vixen but did not definitely establish this fact. I did, however, feel the abdomen of the deceased to determine that: there was still body heat, no sign of puppies awaiting birth, the fur was very wet over the whole body (since the other fox was dry, and was feverishly licking, I assumed that he had been responsible for the wetting). I decided to remove the corpse from the pavement and grabbed it by the tail and pulled towards the shoulder of the road. The living fox objected to this by biting the fur around the neck and pulling in the opposite direction. When I pushed him away with my hand, he whined but showed no viciousness. I moved the dead fox off the shoulder and down the embankment where there would be no danger of the remaining fox being run down. I considered burying the dead but decided against it with the thought that it would only be dug out again. Before returning to the car, I noted that there was considerable blood about the mouth of the dead fox and that the live one was not concerned about licking this off. Also, on parting, I again scratched the ears of the male fox and patted him on the side; he wagged his tail a little.

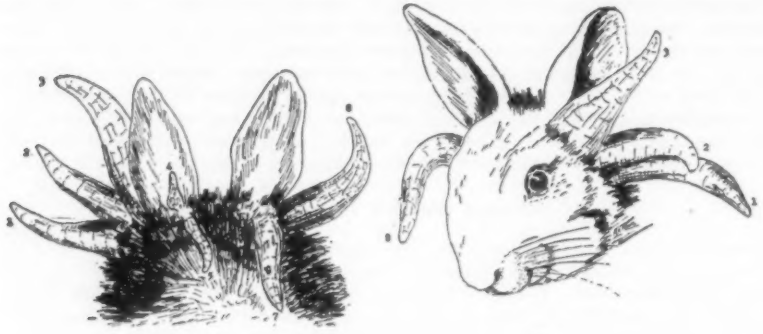
Having seen many red foxes, I have no doubt concerning the identity of these animals but I cannot explain the behavior.—William P. Comstock, Jr., *117 Lincoln Avenue, Newark 4, New Jersey.*

NOTE OF A "HORNED" COTTONTAIL FROM NORTHWEST MISSOURI

A cottontail, *Sylvilagus floridanus mearnsii*, having eight horn-like protuberances about the head, was shot November 28, 1946, by Vernon Green, Jr., while hunting approximately four miles north of St. Joseph, in Andrew County, Missouri. Other cases of this skin disease in rabbits have been recorded (Barbour, Proc. Nebr. Ornith Union, vol. 2, pp. 61–63, 1901; Seton, Lives of Game Animals, 1929; Hendrickson, Iowa State College Jour. Sci., vol. 10, pp. 367–371, 1936).

The growths were distributed as shown in fig. 1, A (rear view) and B (three-quarters front view). These protuberances were soft and rubber-like and, when flexed, they returned slowly to their original position. In preparing the mount, all growths were removed with the skin. The total length and basal diameter of each growth are listed in the table below. Reference is made to the numbered 'horns" (A) for the location of each growth described as follows: Two long horns (1 and 2), fused at the base for one-third their length,

below the left ear; one large, long horn (3), anterior to and extending beyond the left ear, which measured 50.4 mm.; two short horns (4 and 5), behind the left ear, the longer of



A B

FIG. 1. A. "Horns" of a cottontail, rear view.
B. "Horns" as seen in three-quarter view.

which extended posteriorly, parallel to the neck; one short horn (6) behind the right ear; two large horns (7 and 8) just below the right ear, the longer of which curved anteriorly.

NUMBERED HORN-LIKE GROWTH	TOTAL LENGTH (MILLIMETERS)	DIAMETER AT BASE (MILLIMETERS)
1	63.5 } fused	24.6
2	54.1 }	
3	70.0	25.8
4	14.5	6.0
5	25.9	5.3
6	12.2	3.9
7	39.7	11.5
8	73.1	17.8

There have been several cases previously reported in Missouri of horn-like growths on rabbits. A cottontail having three "horns" was found in Cooper County near Pilot Grove, in 1931; an island in the Missouri River near Waverly is reported to have harbored several of these diseased rabbits. Other reports of "horned" rabbits have come from Clinton, Springfield, and Joplin. All of these oral records were received while I was studying cottontail populations in Missouri.—KENNETH C. ROWE, *Missouri Conservation Commission, Columbia, Missouri.*

THE RACCOON AS A PREDATOR ON TURTLES

It is fairly well known that raccoons dig out and eat turtle eggs, but that they prey on adult turtles, break the neck, chew the head and throat, and remove the oviducts and other internal organs apparently has not been previously reported.

Fifty adult female *Pseudemys scripta scripta* and 15 *Kinosternum subrubrum subrubrum* were captured and marked according to the system of Cagle (*Copeia*, no. 3, pp. 170–173, 1939) at the U. S. Fish and Wildlife Service's Savannah River Refuge, South Carolina, in connection with cooperative studies of the U. S. Public Health Service and the U. S. Fish

and Wildlife Service on the effects of DDT on wildlife. Turtles were taken from early April to early July, but the largest number was marked in May at the height of the egg-laying season. Ordinarily very circumspect, the female *P. scripta scripta*, driven by the urge to oviposit, is readily captured at this time.

It was soon discovered that this turtle was an easy prey for raccoons. Four newly killed female *P. scripta scripta* were found in May, 20 in June, and 2 in July. Four dead *K. subrubrum subrubrum* were found in June. The first signs of violence that were noted were chewed heads and throats and broken necks. On closer examination it was found that the intestines, oviducts, and other internal organs of most specimens had been pulled through the anal opening. Egg shells were sometimes found near a carcass, and raccoon tracks were noted when the carcass lay on sand. One raccoon was frightened away from a freshly killed and eviscerated turtle.

Raccoons were the most abundant carnivores on the Refuge, and 83 observations were made on them in 424 miles of driving. One otter was the only other carnivore observed.

Forty-nine female *P. scripta scripta*, either ovipositing or preparing to oviposit, were marked and released on the Refuge, but none of these was subsequently found killed by raccoons. Twenty-six unmarked adult females, however, were found killed. Raccoons also excavated many cluthes of eggs and thus further reduced the population of this turtle. Fifteen *K. subrubrum subrubrum* were marked and released, of which 4 or 26.6 percent were later found killed by raccoons. Because they are smaller in size and are more easily overlooked than *P. scripta scripta*, it is possible that a larger percentage of ovipositing female *K. subrubum subrubrum* were killed by raccoons than the figures indicate.—Arnold B. Erickson and Harvey I. Scudder, *U. S. Public Health Service, Savannah, Georgia.*

COMMENTS ON MIGRATION AND HIBERNATION IN TADARIDA MEXICANA

The note by Christensen in this Journal (vol. 28, no. 1, pp. 59–60) concerning *Tadarida mexicana* is of interest in exemplifying the lack of detailed knowledge concerning the habits of many of our most common species of bats. Christensen's interpretation of his observations, namely, that the colony of *Tadarida mexicana* at Carlsbad Caverns migrates, and does not hibernate, seems convincing at the first reading, but I do not consider that it is necessarily correct. All that it really shows, if we accept his evidence, is that the colony is apparently at a maximum in early fall, diminishes and disappears in winter, and that the bats observed were not completely torpid. Christensen does not explain his meaning of the term migration sufficiently to make it clear whether he means a local shift or a long one, but the implication is that the bats move to a place where there is an adequate supply of insects. This necessarily would mean a considerable distance. The assumption of migration in this sense may be true, but there is no real evidence for it and probably none will be available until banding studies are made.

Also unclear to me are his statements concerning hibernation. I understand him to mean that *Tadarida mexicana* does not become torpid. That *Tadarida mexicana* does become torpid is abundantly clear to me from many observations and is also indicated in the literature. For example, in Bailey's book "Animal life of the Carlsbad Cavern" cited by Christensen, there are observations on torpidity that I do not doubt. This may be a quibble, depending on the definition of hibernation. The fact is, however, that *Tadarida mexicana* reacts as do the vespertilionid bats to low temperatures. That is to say, at any time of year, the body temperature of *Tadarida mexicana* when at rest approaches that of its surroundings. When the temperature becomes low enough the bats become torpid, although, as is also true of vespertilionid bats, they can revive when stimulated, or even independently of external stimulation, even when the temperature remains low. To cite only one instance of torpidity among many, on December 1, 1946, at Bear Creek, 6½ miles southeast of Wilbur Springs, Colusa County, California, Mary Ramage, Carl Koford and I found 8 *Tadarida mexicana* in a space between supporting timbers of a bridge. They were removed, banded, and returned to the crack. They were able to move only feebly when first found, and did not revive sufficiently during the short period of handling to be able to

fly but had considerably increased their activity. The air temperature was not measured but beneath the bridge it was probably below 50°F. At 55 degrees, which, according to Bailey's statements, is probably a nearly constant temperature in the Carlsbad Caverns, bats would not be completely torpid and should be able to become fully active rather quickly. The important point is that *Tadarida mexicana* reacts to low temperatures as do the vespertilionids and so presumably has the physiological mechanism that would permit it to hibernate. One example from the literature showing that molossids become torpid is present in the same paragraph from Allen's book "Bats" quoted in part by Christensen, namely, that *Eumops californicus*, a molossid related to *Tadarida*, was observed to be dormant for more than a month.

I have no completely convincing evidence that *Tadarida mexicana* does not migrate over considerable distances, but rather intensive work on most species of bats in California in the last two years has caused me to doubt that migration, other than local movements, is a common phenomenon among them. Absence of bats in winter from localities inhabited in summer is one of the first facts a bat collector encounters. He also commonly encounters among the people familiar with summer colonies the belief that the bats migrate, presumably far south to Central or South America. This is an appealing and satisfactory explanation to the ordinary person. What has caused me to doubt it is that most of our North American species do not visit those southern areas. Furthermore, in California, where there is a great diversity of climate, and where many bat species have sharply marked subspecies, bat subspecies are not found out of their geographic areas. We now have winter specimens of most of the species and subspecies and none of these are out of place. We do, however, have considerable difficulty in finding bats in winter, but we have found enough to point toward the conclusion that the bats, while remaining in the same general area, leave their summer and fall retreats and seek out more secluded ones to pass the winter. Also I suspect that here they tend to scatter in small groups rather than congregate in large ones. This is the reverse of the situation in areas where winters are severe, where a few species are known to migrate and most species congregate in caves to escape extremely low temperatures. As regards *Tadarida mexicana* in California, it seems certain that it is a permanent resident in the northern part of its range where conditions may not permit it to fly for periods of considerable length.

I conclude that there is a possibility the colony at Carlsbad Caverns, granting that it does not remain there in winter, may merely move to some place in the same general area possibly better suited for winter existence. It is not necessary to assume that it undertakes a long migration, since disappearance in winter parallels the situation in California for many species for which there is no evidence for migration, but considerable evidence that they shift to other retreats in the same area in winter. The colony at Carlsbad may perform migrations, but as I see it, it is not proven that it does. Christensen's observations are not convincing evidence and do not permit the generalization that *Tadarida mexicana* is migratory and does not hibernate. Further observations, particularly banding work, are necessary before the real facts are known.—Seth B. Benson, *Museum of Vertebrate Zoology, Berkeley, California.*

THE ISTHMIAN CAPYBARA IN THE CANAL ZONE

In January 1947, Mr. Henry Van Horn, river supervisor for the Santa Rosa Station of the Gorgas Memorial Laboratory, shot a capybara, *Hydrochoerus isthmius* Goldman, on the east bank of the mid-basin of the Chagres River about one mile below Juan Mina, Canal Zone. Neither he, nor the other inhabitants of the area, had ever before seen an animal like it. Dr. Herbert C. Clark, who has camped and hunted since 1909 on the headwaters of the Chagres as well as on the middle Chagres area has never seen or heard of an authentic record of this animal there. This record is thus the first for the species west of the Tuyra River in Darien (the type locality) and the first for the species in the Canal Zone. The single specimen collected was unfortunately eaten, but the skull was saved and has been deposited in the U. S. National Museum (No. 282370). A second capybara was seen feeding

in company with the one collected and has been observed at the same place subsequently. The river bank here is overgrown with heavy emergent grasses, with a stand of tall bamboo behind.

Whether the capybara has succeeded in extending its range up the Chucunaque River (the main western tributary of the Tuyra River) and across the divide to the Bayano drainage and hence to the Chagres, or whether the individuals now appearing along the Chagres River are escapes from some unknown collector is uncertain. In any event, the formation of Gatun and Madden lakes, as a consequence of the construction of the Panama Canal, has created numerous favorable habitats for the capybara. The habitat in which they are now being observed on the Chagres River is similar to that from which the species was described in Darien. The species is still thriving in the vicinity of the type locality near El Real de Santa Maria, Darien Province, as a group of almost a dozen was observed there recently (March 1947) grazing with cattle along the bank of the Tuyra River.

Dr. Remington Kellogg has kindly compared the skull of the Chagres River capybara with the type of *Hydrochoerus isthmius* Goldman and finds it slightly larger, but smaller than specimens from northern Colombia and with less inflated bullae.

We do not contemplate further efforts to collect the other individual seen, as might be desirable for comparative purposes, until it is evident that the species has become established in this new locality.—Harold Trapido, *Gorgas Memorial Laboratory, Apartado 1252, Panamá, Republica de Panamá.*

SPOTTED SKUNK IN PENNSYLVANIA

Three separate occurrences of the Alleghenian spotted skunk, *Spilogale putorius*, in southern Pennsylvania have been investigated by the writers. Two specimens were taken on Sidling Hill Mountain, Union Township, Fulton County, by one trapper—one in November 1946, and one in the fall of 1945. A third was taken in the same locality, along with eleven striped skunks, *Mephitis mephitis nigra*, from beneath an abandoned chicken house in mid-winter about 40 years ago. This specimen appeared to be "denning" in perfect harmony with the striped skunks. Another specimen was reported killed about four miles west of Hancock, Maryland, about 1944.

The authenticity of these records was established by careful investigation, and the pelt of the animal taken in 1946 was secured by the writers and is now in the collection of the Pennsylvania Mammal Survey at the Carnegie Museum, Pittsburgh, Pennsylvania.

The present range of *Spilogale putorius* as defined by Howell, Anthony, and Hamilton establishes the northern limit in northern Virginia. The northeasternmost occurrence previously reported was a specimen taken near Winchester, Virginia. The Pennsylvania records place the northern limit of its range about sixty miles farther north.—Roger M. Latham and C. R. Studholme, *Pennsylvania Game Commission, Harrisburg, Pennsylvania.*

CORRECTION

In my note on the hoary bat (Jour. Mamm., vol. 28, no. 3, p. 293) the name *Lasiurus borealis* was used instead of the correct name *Lasiruus cinereus*. The switching of names of species I have known for many years must be charged to inexcusable carelessness.—S. C. Bishop.

CORRECTION

The article by T. J. Courtney on "Baby Beavers" in the August number of this Journal (Jour. Mamm., vol. 28. no. 3, pp. 228–230, 1 fig.) actually describes and figures young muskrats (*Ondatra zibethicus*). Your editor was caught napping on this one. W. B. Davis, Editor

REVIEWS

Hubbard, Clarence Andresen. FLEAS OF WESTERN NORTH AMERICA: THEIR RELATION TO THE PUBLIC HEALTH. 1947. pp. 1–533, 5 plates, 235 text figures. The Iowa State College Press, Ames, Iowa. $6.00.

This is by far the most ambitious American publication on Siphonaptera to appear since the two monumental works of C. F. Baker—"A Revision of the American Siphonaptera" in 1904, and "Classification of the American Siphonaptera" in 1905. Included are the fleas, and their hosts, found in a zone west of the 100th meridian, and the relation of the fleas to the public health. This treatise is timely due to the emphasis currently being placed on the investigation of arthropod transmission of diseases. As certain species of fleas are known to transmit sylvatic plague and endemic murine typhus, proper identification to species is of great importance.

The book is divided into three parts. Part one includes an unusual feature in the excellent history of the students of western American fleas, with photographs and publications of the principal early and contemporary siphonapterists. Of particular interest are the life histories of the pioneers in this study, Carl F. Baker, N. Charles Rothschild, and Karl Jordan. This chapter is followed by a discussion of the medical importance of fleas, field techniques in capturing the hosts and collecting the fleas, and the anatomy of the flea in relation to its taxonomy.

Part two, consisting of 345 pages, is devoted to a detailed taxonomic study of the five families, 66 genera, and 236 species and subspecies of Siphonaptera known to the author. A large part of the records were made by the writer himself, who has collected this Order of insects intensively since 1934. Keys are provided for the identification of families, genera, and for the species and subspecies of almost all the genera. All species are adequately and clearly described, separated from closely related species, and for the most part, figured. All available locality and host records are given as well as the type host and type locality.

Of particular interest to mammalogists will be the third and last section dealing with the flea hosts. The mammalian fauna of the western United States is particularly rich in rodents, and from the Order Rodentia, numerous locality records are given for 29 genera as hosts for various species of fleas. Three genera of Lagomorpha, 15 genera of Carnivora, 4 genera of Insectivora, and 6 genera of Chiroptera are also listed as flea hosts.

The author is to be congratulated for this worthwhile contribution to entomological literature, and to public health work.—R. B. EADS.

RECENT LITERATURE

(Conducted by Gerrit S. Miller, Jr., Remington Kellogg, and Emma M. Charters)

[Reprints of this section may be purchased from the Corresponding Secretary]

ABBOTT, JACOB BATES. Vanishing Americans. Pt. 1. South Dakota Conserv. Digest, Pierre, vol. 13, no. 7, pp. 12–13. July, 1946. (Grizzly bear, caribou.)

ABBOTT, ROY L. Porky—oaf of the woods. Fauna, Philadelphia, vol. 8, no. 4, pp. 118–119. illus. December, 1946.

AITCHISON, JAMES. Hinged teeth in mammals: a study of the tusks of muntjaks (*Muntiacus*) and Chinese water deer (*Hydropotes inermis*). Proc. Zool. Soc. London, vol. 116, pt. 2, pp. 329–338, figs. 3. November, 1946.

ALLEN, B. RANDOLPH. A word to the cottontail hunter. Virginia Wildlife, Richmond. vol. 7, no. 4, pp. 6–7. October, 1946. (Tularemia.)

ANDERSON, RALPH H. A wild cat kitten. Nat. Hist., New York, vol. 55, no. 9, pp. 430–431, illus. November, 1946.

ANONYMOUS Castor canadensis. Beaver, Winnipeg, outfit 277, pp. 26–27, illus. September, 1946. (Ten photos of beavers.)

——— Beaver benefit by, and aid in, conservation. Missouri Conservationist, Jefferson City, vol. 7, no. 9, pp. 8–9, illus. September, 1946.

——— Ohio squirrels. Ohio Conserv. Bull., Columbus, vol. 10, no. 9, p. 3, illus. September, 1946.

——— Our only marsupial. Fauna, Philadelphia, vol. 8, no. 3, pp. 80–81, illus. September, 1946. (Opossum.)

——— [Photo of Brazilian tapir and its young.] Fauna, Philadelphia, vol. 8, no. 3, p. 66. September, 1946.

——— Les invasions de lemmings. La Nature, Paris, no. 3119, pp. 269–270, figs. 3. September 1, 1946.

——— Mink whiter than albino. Science News Letter, Washington, vol. 50, no. 10, p. 156, illus. September 7, 1946.

——— Porcupines destroy bean crop. Colorado Conserv. Comments, Denver, vol. 9, no. 3, p. 16. September 15, 1946.

——— Antarctic whaling. British ships hunt huge animals for edible oil. Life, New York, vol. 21, no. 14, pp. 123–126, illus. September 30, 1946.

——— Utah's antelope hunt is huge success, claim sportsmen. Utah Fish & Game Bull., Salt Lake City, vol. 3, no. 6, pp. 1–2. September–October, 1946.

——— Rats on Midway. Rodent Mail, Rats and Mice, London, vol. 2, no. 8, pp. 91–92, illus. October, 1946.

——— Here and there. San Diego Zoonooz, vol. 19, no. 10, p. 5, illus. October, 1946. (Chinchilla, sloth, hedgehog, wallaby.)

——— Bounty on bears. Maryland Tidewater News, Solomons, vol. 3, no. 5, p. 4. October, 1946. (Bounty placed in 1744 in Maryland.)

——— Lad kills rabid fox attacking brother. West Virginia Conservation, Charleston, vol. 10, no. 7, p. 29. November, 1946.

——— Deer hunting information. Michigan Conservation, Lansing, vol. 15, no. 10, p. 16. November, 1946.

——— Albino elk. Oregon Game Comm. Bull., Portland, vol. 1, no. 8, p. 4. November, 1946.

——— New antelope. San Diego Zoonooz, vol. 19, no. 11, pp. 5, 7. November, 1946. (Blesbok and greater kudu.)

——— Foxes as snake-killers. Victorian Nat., Melbourne, vol. 63, no. 7, p. 159. November, 1946.

——— There were elephants in Illinois. Living Museum, Springfield, vol. 8, no. 7, pp. 145–146, illus. November, 1946. (Mammoth.)

ANONYMOUS Round the map. Rodent Mail, Rats and Mice, London, vol. 2, no. 10, pp. 111–113. December, 1946. (Rats)

———— The trail of the rat. Rodent Mail, Rats and Mice, London, vol. 2, no. 10, pp. 113–114, illus. December, 1946.

———— Oscar achieves posthumous fame. Academy News Letter, California Acad. Sci., San Francisco, no. 84, pp. 3–4. December, 1946. (Captive harbor seal with four pounds of pennies in its stomach.)

———— Zoo news. Fauna, Philadelphia, vol. 8, no. 4, pp. 126–127, illus. December, 1946. (Spotted hyena, black wolf, DeBrazza's monkey.)

ANTHONY, J. L'évolution des plis de passage pariéto-occipitaux de Gratiolet chez les singes platyrhiniens. Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 15, no. 5, pp. 267–274, figs. 2. July–September, 1943.

———— La genèse du crochet de l'hippocampe. Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 17, no. 4, pp. 286–291, figs. 3. May, 1945.

AUERBACH, M. Die Wirbeltiere Badens in ihrer Beziehung zur Umwelt und zur Landschaftsform. Beiträge Naturk. Forschung Südwestdeutschland, Karlsruhe, vol. 5, pp. 1–54. 1940.

BAILEY, JOHN WENDELL. The mammals of Virginia. An account of the furred animals of land and sea known to exist in this Commonwealth with a list of the fossil mammals from Virginia. Privately printed, Richmond, pp. xvi + 416, frontisp., figs. 96. December, 1946.

BAILLIE, JAMES L., JR. Naturalists on Hudson Bay. Beaver, Winnipeg, outfit 277, pp. 36–39, illus. December, 1946. (Historical.)

BAKER, ROLLIN H. A study of rodent population on Guam, Mariana Islands. Ecological Monographs, Durham, vol. 16, no. 4, pp. 393–408, figs. 11. October, 1946.

BARTLETT, I. H. Deer hunting is improving in Keeweenaw. Michigan Conserv., Lansing, vol. 15, no. 10, pp. 7, 13. November, 1946.

BASSETT, CHARLES F., and LEONARD M. LLEWELLYN. Timing fox matings for maximum production. Amer. Fur Breeder, Duluth, vol. 19, no. 6, pp. 46, 48, 50, 52. December, 1946.

BENSON, SETH B. Description of a subspecies of Myotis yumanensis from Baja California, Mexico. Proc. Biol. Soc. Washington, vol. 60, pp. 45–46. May 19, 1947. (New: *Myotis yumanensis lambi*.)

BERRY, REE M. Iowa furs make high quality garments. Iowa Conservationist, Des Moines, vol. 5, no. 11, pp. 81, 83–84, illus. November 15, 1946.

BEZDEK, FRANCES H. Unsuccessful attempts at collecting semen from captive foxes. Amer. Fur Breeder, Duluth, vol. 19, no. 6, pp. 54, 56. December, 1946.

BLACKFORD, JOHN L. Cone year. Nature Magazine, Washington, vol. 39, no. 8, pp. 409–412, 442, illus. October, 1946. (Red squirrel.)

BLAIR, W. FRANK An estimate of the total number of beach-mice of the subspecies *Peromyscus polionotus leucocephalus* occupying Santa Rosa Island, Florida. Amer. Nat., Lancaster, vol. 80, no. 795, pp. 665–668. November–December, 1946.

BOARDMAN, W. The hair tracts of marsupials. Part 11. Description of species, continued. Proc. Linnean Soc. New South Wales, Sydney, vol. 70, pts. 5–6, pp. 179–202, figs. 43. July 15, 1946.

BORISSIAK, A. A. A new chalicothere from the Tertiary of Kazakhstan. Akad. Nauk SSSR. Trudy Paleontologicheskii Institut, Moscou, vol. 13, no. 3, pp. 1–134, figs. 37, pls. 14. 1946. (New: *Phyllotillon betpakdalensis*.)

BOUNDS, LEMANN H., and RICHARD M. KINGERY. Weil's disease, report of eleven cases. U. S. Naval. Med. Bull., Washington, vol. 46, no. 12, pp. 1808–1812. December, 1946. (At Zamboanga, Philippine Islands; rats suspected of spreading the disease.)

BRADT, G. W. The raccoon—masked clown of the woodlots. Michigan Conservation, Lansing, vol. 15, no. 8, pp. 6–7, illus. September, 1946.

BRADT, G. W. Cottontail rabbit—big game of the small boy. Michigan Conservation, Lansing, vol. 15, no. 9, pp. 4–5, illus. October, 1946.

——— The whitetailed deer—big business in the North Country. Michigan Conservation, Lansing, vol. 15, no. 10, pp. 4–5, illus. November, 1946.

BRENNAN, JAMES M. Two new species of *Trombicula: T. montanensis* and *T. aplodontiae* (Acarina, Trombiculidae) from northwestern United States. Jour. Parasitol, Lancaster, vol. 32, no. 5, pp. 441–444. October, 1946. (*Cynomys, Aplodontia*)

BRIDGES, HENRY P. How to catch a fox. Field and Stream, New York, vol. 51, no. 5, pp. 38–39, 84, illus. September, 1946.

BRIDGES, WILLIAM The Belgium Congo's gift to the New York Zoological Society. Animal Kingdom, New York, vol. 49, no. 5, pp. 158–164, illus. September–October, 1946. (Elephants.)

——— How to weigh a gorilla. Animal Kingdom, New York, vol. 49, no. 6, pp. 200–203, illus. December 16, 1946.

BROMAN, IVAR Über die Entstehung der Tasthaare und der von diesen unabhängigen Fellhaare bei Procavia-Embryonen, nebst Bemerkungen über einige phylogenetische Konzequenzen dieser Befunde. Lunds Univ. Årsskrift, Lund, n.f., avd. 2, vol. 42, no. 9, pp. 1–50, figs. 28. 1946.

BRONGERSMA, L. D. Note on Mustela lutreolina Rob. & Thos. Temminckia, Leiden, vol. 5, pp. 257-263, figs. 2. 1940.

——— On the remains of Carnivora from cave deposits in Java and Sumatra, with notes on Recent specimens. I. Zool. Mededeelingen, Leiden, vol. 23, nos. 1–2, pp. 114–148, fig. 1, pl. 4. November, 1941.

——— De hoogere apen en hun verspreiding in het geologisch verleden. Mensch en Maatschappij, Tweemaandelijksch Tijdschrift, Amsterdam, vol. 18, nos. 3–4, pp. 130–140, figs. 2. May–July, 1942.

BRONSON, WILFRID S. Coyotes. Harcourt, Brace and Co., New York, pp. 58 (not numbered), illus. 1946. (For children.)

BROOM, ROBERT. The first white rhino in captivity. Nat. Hist., New York, vol. 55, no. 9, pp. 432–433, illus. November, 1946.

——— The illustrations of the Australopithecinae. Nature, London, vol. 158, no. 4020, p. 714. November 16, 1946.

BROWN, E. K., and G. W. JONES. What about the bighorn? Colorado Conserv. Comments, Denver, vol. 9, no. 3, pp. 10–11. September 15, 1946.

BRUNER, JOYCE A., and EMIL WITSCHI. Testosterone-induced modifications of sex development in female hamsters. Amer. Jour. Anat., Philadelphia, vol. 79, no. 2, pp. 293–320, figs. 15. September, 1946.

BURROUGHS, R. D. Game refuges and public hunting grounds in Michigan. Jour. Wildlife Management, Menasha, vol. 10, no. 4, pp. 285–296. October, 1946.

BURT, WILLIAM HENRY. [Review of] The California ground squirrel: a record of observations made on the Hastings Natural History Reservation, by Jean M. Linsdale. Science, Lancaster, vol. 104, no. 2705, p. 430. November 1, 1946.

BUTCHER, EARL O. Effects of sodium flouride on hair growth in the rat. Proc. Soc. Exper. Biol. and Med., Utica, vol. 63, no. 2, pp. 474–476, fig. 1. November, 1946.

BUTLER, P. M. The evolution of carnassial dentitions in the Mammalia. Proc. Zool. Soc. London, vol. 116, pt. 2, pp. 198–220, figs. 13. November, 1946.

CABRERA, ANGEL. Sobre la sistematica del venado y su variacion individual y geografica. Rev. Mus. La Plata, n.s, vol. 3, no. 18, pp. 1–42, figs. 7, pl. 1. February 5, 1943. (News: *Ozotoceros bezoarticus celer*.)

CALHOUN, LOIS Bone marrow of horses and cattle. Science, Lancaster, vol. 104, no. 2705, p. 423. November 1, 1946.

CARR, WILLIAM H. Wild pigs of the desert. Nat. Hist., New York, vol. 55, no. 8, pp. 352–355, 392, illus. October, 1946. (Peccary.)

CASTLE, W. E. Color inheritance in mink. Amer. Fur Breeder, Duluth, vol. 19, no. 5, pp. 8, 12. November, 1946.

CHACE, LYNWOOD. Bears like honey—but think twice before you try to film them eating it. Nat. Hist., New York, vol. 55, no. 8, pp. 376–380, illus. October, 1946.

CHANG, M. C. Effect of dilution on fertilizing capacity of rabbit spermatozoa. Science, Lancaster, vol. 104, no. 2703, pp. 361–362. October 18, 1946.

CHAPMAN, FLOYD B. Deer damage control. Ohio Conserv. Bull., Columbus, vol. 10, no. 9, pp. 12–13, illus. September, 1946.

CHAPMAN, JIM. Tricky Don Coyote. Outdoorsman, Chicago, vol. 88, no. 6 (whole no. 523), pp. 23, 34–36. November–December, 1946.

CHURCHER, PAUL Red fox—resourceful resource. Conserv. Volunteer, St. Paul, vol. 9, no. 54, pp. 8–12. September–October, 1946.

CHUTE, VERNE. Mojave Joe. Sports Afield, Minneapolis, vol. 116, no. 4, pp. 43, 124–127, illus. October, 1946. (Coyote.)

CLARK, J. G. D. Seal-hunting in the Stone Age of north-western Europe: a study in economic prehistory. Proc. Prehistoric Soc., London, n.s., vol. 12, pp. 12–48, figs. 11. 1946.

CLARK, NOBLE. Facing facts in fur farming. Nat. Fur News, Denver, vol. 18, no. 8, pp. 15, 31, 50. September, 1946.

COLE, LA MONT C., and JEAN A. KOEPKE. A study of rodent ectoparasites in Mobile, Ala. Public Health Repts., Washington, vol. 61, no. 41, pp. 1469–1487. Oct. 11, 1946.

COOK, DAVE. Concerning predators. Pt. 1. South Dakota Conservation Digest, Pierre, vol. 13, no. 8, pp. 6–7. August, 1946.

COOK, FANNYE A. Squirrels. Mississippi Game and Fish, Jackson, vol. 10, no. 4, pp. 1, 2. October, 1946.

——— Rabbits. Mississippi Game and Fish, Jackson, vol. 10, no. 4, pp. 3, 4. October, 1946.

COOPER, KENNETH W. The occurrence of the mite *Cheyletiella parasitivorax* (Megnin) in North America, with notes on its synonymy and "parasitic" habit. Jour. Parasitol. Lancaster, vol. 32, no. 5, pp. 480–482. October, 1946. (Snowshoe rabbit and cottontail).

CORBETT, JIM. Man-eaters of Kumaon. Field and Stream, New York, vol. 51, no. 7, pp. 23–27, 59–60, 117–118, illus. November, 1946. (Tigers.)

COUEY, FAYE M. Antelope foods in southeastern Montana. Jour. Wildlife Management, Menasha, vol. 10, no. 4, p. 367. October, 1946.

CRAFTS, ROGER C. The effects of iron, copper and thyrozine on the anemia induced by hypophysectomy in the adult female rat. Amer. Jour. Anat. Philadelphia, vol. 79, no. 2, pp. 267–291, figs. 19. September, 1946.

CRANDALL, LEE S. Five ways of obtaining animals. Animal Kingdom, New York, vol. 49, no. 5, pp. 165, 170, illus. September–October, 1946. (Zoo animals.)

CRESPO, JORGE A. Contribucion al conocimiento de la ecologia de algunos dasipodidos (Edentata) argentinos. Rev. Argentina Zoogeogr., Buenos Aires, vol. 4, nos. 1–2, pp. 7–39, pls. 9. 1945.

——— Relaciones entre estados climaticos y la ecologia de algunos roedores de campo (Cricetidae). Rev. Argentina Zoogeogr., Buenos Aires, vol. 4, no. 3, pp. 137–144, pls. 2. 1945.

CURTIS, JAMES D. What they say about Porky. Amer. Forests, Washington, vol. 52, no. 10, pp. 474–475, illus. October, 1946. (Porcupine)

DALE, DON. Prairie dogs as pets. Oklahoma Game and Fish News, Oklahoma City, vol. 2, no. 12, pp. 6–7, illus. December, 1946.

DARLING, J. RODGER. Animals of the Bible. Fauna, Philadelphia, vol. 8, no. 4, pp. 114–117, illus. December, 1946.

DAVIES, FRANCIS and ERIC T. B. FRANCIS. The conducting system of the vertebrate heart. Biol. Rev. Cambridge Philos. Soc. vol. 21, no. 4, pp. 173–188. October 1946.

DAVISON, VERNE E. False principles delay advancement in wildlife techniques. Jour. Wildlife Management, Menasha, vol. 10, no. 4, pp. 296–299. October, 1946.

DAWSON, ALDEN B. The effects of lactation on the postpartum involution of the uterus of the cat. Amer. Jour. Anat., Philadelphia, vol. 79, no. 2, pp. 241–265, pls. 3. September, 1946.

DAY, ALBERT M. Wildlife and the American Indian. Sports Afield, Minneapolis, vol. 116, no. 4, p. 17. October, 1946.

DEAN, FRED. A note on the food of the water vole. Naturalist, London, no. 819, p. 153. October–December, 1946.

DEDERER, MICHAEL E. Market types of fox and mink. Nat. Fur News, Denver, vol. 18, no. 8, pp. 14, 34, 47. September, 1946.

DEGROFF, OLGA F. A squirrel in the family. Audubon Mag., New York, vol. 48, no. 6, pp. 369–372, illus. November–December, 1946.

DEHAUT, E. G. Sur l'évolution des dessins tégumentaires mammaliens. Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 15, no. 2, pp. 75–78, figs. 2. February, 1943.

——— Sur la signification du triple facies géographique dont les *Dicotyles*, Cuvier sont empreints. Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 17, no. 1, pp. 32–36, figs. 2. January, 1945.

DERANIYAGALA, P. E. P. Some mammals of the extinct Ratnapura fauna of Ceylon. Spolia Zeylanica (Geol., Zool., Anthropol.), Colombo, vol. 24, pt. 3, pp. 161–171, pls. 21–23. November 8, 1946. (New: *Rhinoceros sondaicus simplisimus*.)

DEVOS, ANTHONY. Tasmania's vanishing marsupials. Nature Mag., Washington, vol. 39, no. 9, pp. 482–484, illus. November, 1946.

DICKIE, MARGARET M., and GEORGE W. WOOLEY. Linkage studies with the pirouette gene in the mouse. Jour. Heredity, Washington, vol. 37, no. 11, pp. 335–337, figs. 6–7. November, 1946.

DIDIER, ROBERT. Étude systematique de l'os penien des mammiferes. Mammalia, Paris, vol. 10, no. 2, pp. 78–91, figs. 9. June, 1946.

DOTTRENS, E. Les phalanges osseuses de *Bos Taurus* domesticus. Rev. Suisse Zool., Geneva, vol. 53, no. 33, pp. 739–774, figs. 27. October, 1946.

DOWNING, STUART. The marmot. Canadian Nature, Toronto, vol. 8, no. 4, pp. 138–140, illus. September–October, 1946.

——— Animals of the plains. Canadian Nature, Toronto, vol. 8, no. 5, pp. 152–153, illus. November–December, 1946. (Bison, pronghorn antelope.)

——— The mountain lion. Canadian Nature, Toronto, vol. 8, no. 5, pp. 154–155, colored plate. November–December, 1946.

DUBOIS, EUG. The fossil human remains discovered in Java by Dr. G. H. R. von Koenigswald and attributed by him to Pithecanthropus erectus, in reality remains of Homo sapiens soloensis. Proc. K. Nederlandsche Akad. Wetenschappen, Amsterdam, vol. 43, no. 4, pp. 494–496, pls. 1–2; no. 7, pp. 842–851, pls. 1–4; no. 10, pp. 1268–1275. 1940.

DUFRESNE, FRANK. Alaska's animals and fishes. A. S. Barnes and Co., New York, pp. xviii + 297, illus. (13 colored plates). 1946. (Illustrated by Bob Hines; foreword by Alexander Wetmore.)

EAST, BEN Lord of the northern trails. Animal Kingdom, New York, vol. 49, no. 5, pp. 171–176, illus. September–October, 1946. (Moose.)

EPSTEIN, H. The Hejaz dwarf goat. Jour. Heredity, Washington, vol. 37, no. 11, pp. 345–352, figs. 12–18. November, 1946.

ERRINGTON, ALLISON F., and others [Personnel of Epidemiology Unit No. 61]. Tsutsugamushi disease on Samar, Philippine Islands; rats as a reservoir of the disease. U. S. Naval Med. Bull., Washington, vol. 46, no. 11, pp. 1669–1673. November, 1946.

ERRINGTON, PAUL L. Reduction in productivity of muskrat pelts on an Iowa marsh through depredations of red foxes. Journ. Agric. Research, Washington, D. C., vol. 71, no. 4, pp. 137–148. August 15, 1945.

F——, V. Les avions contre les baleines. La Nature, Paris, no. 3122, p. 319. October 15, 1946.

FAUTIN, REED W. Biotic communities of the northern desert shrub biome in western Utah. Ecological Monographs, Durham, vol. 16, no. 4, pp. 251–310, figs. 19. October, 1946.

FINLAYSON, H. H. The red centre. Man and beast in the heart of Australia. Angus & Robertson Ltd., Sydney, pp. 1–153, 57 illus. 1943.

FISH, HAROLD S., and CURT P. RICHTER. Comparative numbers of fungiform and foliate papillae on tongues of domestic and wild Norway rats. Proc. Soc. Exper. Biol. and Med., Utica, vol. 63, no. 2, pp. 352–355, fig. 1. November, 1946.

FISHER, R. A. A system of scoring linkage data, with special reference to the pied factors in mice. American Nat., Lancaster, vol. 80, no. 794, pp. 568–578. September–October, 1946.

FOOTE, LEONARD E. Vermont's wild game resource. A study of the Vermont hunter. Vermont Fish and Game Serv., State Bull., Pittman-Robertson Ser., Montpelier, no. 14, pp. 48, figs. 16. April 1, 1946.

FOX, IRVING. Three new mites from rats in Puerto Rico. Proc. Biol. Soc. Washington vol. 59, pp. 173–176, figs. 3. December 23, 1946.

FRASER, F. C. Report on Cetacea stranded on the British coasts from 1933 to 1937. Publ. Brit. Mus. (Nat. Hist.), London, no. 12, pp. 56, figs. 11, maps 7. September 1, 1946.

FROELICH, RUSSELL. [Photograph of mandrill.] Science Illus., Louisville, vol. 1, no. 9, p. 55. December, 1946.

FURLONG, E. L. Generic identification of the Pleistocene antelope from Rancho La Brea. Contrib. Paleontol., Carnegie Inst. Washington Publ., no. 551, pp. 135–140, pls. 3. January 25, 1946. (New: *Breameryx*, for *Capromeryx* (?) *minor* Taylor.)

GANIER, ALBERT F., and ALFRED CLEBSCH. Breeding birds of the Unicoi Mountains. Migrant, Nashville, vol. 17, no. 4, pp. 53–59, map. December, 1946. (Includes a list of 12 species of mammals.)

GAZIN, C. LEWIS. Machaeroides eothen Matthew, the sabertooth creodont of the Bridger Eocene. Proc. U. S. Nat. Mus., Washington, vol. 96, no. 3202, pp. 335–347, pls. 45–46. December 16, 1946.

GILBERT, PAUL. Bear studies in Colorado. Colorado Conservation Comments, Denver, vol. 9, no. 3, p. 18. September 15, 1946.

GLAZENER, W. C. Antelope bucks—1946. Texas Game and Fish, Austin, vol. 4, no. 10, pp. 5, 19, illus. September, 1946.

GOODWIN, GEORGE G. Hoofed animals of North America. Pt. 2.—Animals with hollow horns. Pt. 3—Wild pigs. School Nat. League Bull., New York, ser. no. 17, bull. no. 2, pp. 4 (not numbered), illus. October, 1946.

——— Inopinatus—the unexpected. Nat. Hist., New York, vol. 55, no. 9, pp. 404–406, illus. November, 1946. (Barren Ground bear.)

——— Mammals of Costa Rica. Bull. Amer. Mus. Nat. Hist., New York, vol. 87, art. 5, pp. 271–474, figs. 1–50, pl. 17, map. December 31, 1946. (New: *Scotinomys teguina endersi*.)

GRACIE, W. MCAULEY. How much does it cost to kill a rat. Rodent Mail, Rats and Mice, London, vol. 2, no. 10, pp. 109–110. December, 1946.

GRAFF, SAMUEL, HENRY T. RANDALL, GRAY E. CARPENTER, and CUSHMAN D. HAAGENSEN. The milk factor in blood. Science, Lancaster, n. s., vol. 104, no. 2700, p. 289. September 27, 1946. (In mice).

GREEN, EARL L., and MARGARET C. GREEN. Effect of the short ear gene on number of ribs and presacral vertebrae in the house mouse. Amer. Nat., Lancaster, vol. 80, no. 795, pp. 619–625. November–December, 1946.

GREGORY, WILLIAM KING. The monotremes and the palimpsest theory. Bull. Amer. Mus. Nat. Hist., New York, vol. 88, art. 1, pp. 1–52, figs. 1–17, pls. 1–2. January 27, 1947. (New: Subclass *Marsupionta*, to include orders *Marsupialia* and *Monotremata*.)

GROMOVA, VERA. A new fossil horse from central Asia. Comptes Rendus (Doklady) Acad. Sci. URSS, Moscow, vol. 54, no. 4, pp. 347–350. November 10, 1946. (New: *Equus valeriani*.)

——— On the different types of variation of characters in the evolution of animals. Comptes Rendus (Doklady) Acad. Sci. URSS, Moscow, vol. 54, no. 5, pp. 441–444. November 20, 1946. (Mainly in horses.)

GUNN, C. K. Parasites causing deaths in Prince Edward Island foxes. Amer. Fur Breeder, Duluth, vol. 19, no. 3, pp. 56, 58. September, 1946.

——— How genetics assists the fur animal breeder. Amer. Fur Breeder, Duluth, vol. 19, no. 3, pp. 66, 68–71, illus. September, 1946.

——— How genetics assists the fur animal breeder. Fur of Canada, Winnipeg, vol. 12, no. 1, pp. 41–42, 44. October, 1946.

——— Details on mink raising. Fur of Canada, Winnipeg, vol. 12, no. 1, pp. 3–4, 49–50, 52. October, 1946.

HACKER, H. P., and H. S. PEARSON. The growth, survival, wandering and variation of the long-tailed field mouse, Apodemus sylvaticus. II. Survival. By H. P. Hacker. Biometrika, Cambridge, England, vol. 33, pt. 4, pp. 333–361, figs. 5. June 28, 1946.

HAMILTON, W. J., JR. Habits of the swamp rice rat, *Oryzomys palustris palustris* (Harlan). American Midland Nat., Notre Dame, vol. 36, no. 3, pp. 730–736, figs. 6. November, 1946.

HANSTRÖM, BERTIL. The hypophysis in a tiger (Felis tigris) and an Indian elephant (Elephas maximus). Lunds Univ. Årsskrift, Lund, n.f., avd. 2, vol. 42, no. 8, pp. 1–24, figs. 13, pl. 1. 1946.

——— The pituitary in Swedish Insectivora. Arkiv Zool., Stockholm, vol. 38A, pt. 2, no. 7, pp. 1–20, figs. 23. September 30, 1946.

HARRIS, DAVE, and SHALER E. ALDOUS. Beaver management in the northern Black Hills of South Dakota. Jour. Wildlife Management, Menasha, vol. 10, no. 4, pp. 348–353, pl. 22. October, 1946.

HARRISON, DAVID L. An extension of the distribution of Leisler's bat (*Nyctalus leisleri* Kuhl.) in Great Britain. Naturalist, London, no. 819, pp. 147–148, map. October–December, 1946.

HART, DENNIS. The fox-quail problem in North Carolina. Wildlife in North Carolina, Raleigh, vol. 10, no. 3, pp. 13, 18. October, 1946.

HENSLEY, ARTHUR G., and HOWARD TWINING. Some early summer observations on muskrats in a northeastern California marsh. California Fish and Game, San Francisco, vol. 32, no. 4, pp. 171–181, figs. 41–45. October, 1946.

HEPPENSTALL, CAROLINE A. Jumping mice. Pennsylvania Game News, Harrisburg, vol. 17, no. 6, p. 12. September, 1946.

HERMAN, CARLTON M., and ARTHUR I. BISCHOFF. The foot worm parasite of deer. California Fish and Game, San Francisco, vol. 32, no. 4, pp. 182–190. October, 1946.

HIGHBY, PAUL R. Value of 1945 fur catch tops all records. Conservation Volunteer, St. Paul, vol. 9, no 55, pp. 45–49. November–December, 1946.

HILL, JOHN ERIC. Nature's second-hand man. Nat. Hist., New York, vol. 53, no. 2, p. 89, illus. February 1944. (Pack rat.)

——— Self-repair. Nat. Hist., New York, vol. 55, no. 7, p. 337, illus. September, 1946. (Healing of injuries in mammals.)

——— Built-in knapsack. Nat. Hist., New York, vol. 55, no. 8, p. 387, illus. October, 1946. (The camel's hump.)

——— Meat supply. Nat. Hist., New York, vol. 55, no. 9, p. 435, illus. November, 1946. (Meat stored by animals.)

HILL, W. C. OSMAN. Note on the male external genitalia of the chimpanzee. Proc. Zool. Soc. London, vol. 116, pt. 1, pp. 129–132, figs. 2, pl. 1. May, 1946.

HINDLE, EDWARD. Recent additions to the London Zoo. Nature, London, vol. 158, no. 4018, p. 637. November 2, 1946.

HOLLAND, HENRIETTA. The desert canary. Frontiers, Lancaster, vol. 11, no. 1, pp. 24–26, illus. October, 1946. (Burro.)

——— Baa, baa black sheep! That Persian may be from California. Frontiers, Lancaster, vol. 11, no. 2, pp. 47–48, illus. December, 1946. (Karakul sheep, imported in 1905.)

HOOGERWERF, A. Jacht en natuurbescherming op Java gedurende de japansche bezetting. Natuur. Tijdschrift Nederlandsch-Indie, Batavia, vol. 102, no. 9, pp. 205–208. December 1, 1946.

HOWARD, HILDEGARDE. George Willett: May 28, 1879—August 2, 1945. Condor, Berkeley, vol. 48, no. 2, pp. 49–71, figs. 5–13, pl. March–April, 1946.

HUBBS, CARL L. [Review of] Mammals of Nevada, by E. Raymond Hall. Amer. Nat., Lancaster, vol. 80, no. 794, pp. 584–586. September–October, 1946.

HUEBNER, ROBERT J., WILLIAM L. JELLISON, and CHARLES POMERANTZ. Rickettsial pox—a newly recognized rickettsial disease. U. S. Public Health Repts., Washington, vol. 61, no. 47, pp. 1677–1682. November 22, 1946. (Carried by mites on house mice.)

HUGHES, H. Perilobular spaces in the rabbit pancreas. Nature, London, vol. 158, no. 4012, pp. 418–419, figs. 3. September 21, 1946.

IRVING, J. T. Enamel formation in the rat's incisor tooth. Nature, London, vol. 158, no. 4014, p. 486, illus. October 5, 1946.

JACKSON, J. W. A pair of jacks. Nature Mag. Washington, vol. 38, no. 9, p. 480, illus. November, 1946. (Jack rabbit.)

JAHODA, WILLIAM J. Use of oaks by beavers in New Hampshire. Jour. Wildlife Management, Menasha, vol. 10, no. 4, pp. 366–367. October, 1946.

JOHANSSON, IVAR. The descent and race biology of furred animals. Fur of Canada, Winnipeg, vol. 12, no. 1, pp. 12, 14, 16. October, 1946.

JOHNSON, DAVID H. The rat population of a newly established military base in the Solomon Islands. U. S. Naval Medical Bull., Washington, vol. 46, no. 10, pp. 1628–1632. October, 1946.

JOHNSON, S. T. Increasing fox pup production. Nat. Fur News, Denver, vol. 18, no. 8, pp. 11, 38–39. September, 1946.

JONES, GLENN. The raccoon in Oklahoma. Oklahoma Game and Fish News, Oklahoma City, vol. 2, no. 12, pp. 4–5, 7, illus. December, 1946.

KALABUKHOV, N. I., and O. B. POLUZADOVA. Some ecological-physiological characters of the arctic and desert fox species; *Alopex lagopus* L. and *Vulpes corsac* L. Comptes Rendus (Doklady) Acad. Sci. URSS, Moscow, vol. 54, no. 4, pp. 369–372, figs. 3. November 10, 1946.

KALMBACH, E. R., and J. F. WELCH. Colored rodent baits and their value in safeguarding birds. Jour. Wildlife Management, Menasha, vol. 10, no. 4, pp. 353–360. October, 1946.

KEBBE, CHESTER E. Oregon's fur resources. Bull. Oregon State Game Comm., Portland, vol. 1, no. 8, pp. 1, 6–7. November, 1946.

KENT, Jean. Animal stars of "The Yearling." Nature Mag., Washington, vol. 39, no. 9, pp. 465, 468, illus. November, 1946. (Raccoon, deer.)

KING, A. W. The Aleutian blue mink. Fur-Fish-Game, Columbus, vol. 87, no. 9, p. 38. September, 1946.

KLAPPER, CLARENCE E. The development of the pharynx of the guinea pig with special emphasis on the fate of the ultimobranchial body. Amer. Jour. Anat., Philadelphia, vol. 79, no. 3, pp. 361–397, figs. 29. November, 1946.

KOENIGSWALD, G. H. R. VON. Neu Pithecanthropus-Funde 1936–1938; ein Beitrag zur Kenntnis der Praehomiden. Dienst Mijnbouw Nederlandsch-Indie, Wentenschappelijke Mededeelingen, Batavia, no. 28, pp. 1–232, figs. 40, pls. 14. 1940.

KON, LEOPOLD. Contribution a l'étude de la neóformation d'ovules chez les mammifères primitifs adultes. Recherches sur l'ovaire d'Ericulus setosus. Rev. Suisse Zool., Geneva, vol. 53, no. 29, pp. 597–623, figs. 23. October, 1946.

KROGMAN, W. M. [Review of] Apes, giants and man, by Franz Weidenreich. Science, Lancaster, vol. 104, no. 2709, p. 516. November 29, 1946.

KRUSE, WILLIAM A. R. How to make skeletons. VIII. The mounting of a sheep skeleton (conclusion). Ward's Nat. Sci. Bull., Rochester, vol. 20, no. 1, pp. 9–10, figs. 1–6. September, 1946.

KRUSHINSKY, L. V. Role of genotypical and humoral factors in the development and behaviour of rats. Comptes Rendus (Doklady) Acad. Sci. URSS, Moscow, vol. 52, no. 6, pp. 541–544, figs. 2. May 30, 1946.

LANE, FRANK W. Strange uses for animals. Nat. Hist., New York, vol. 55, no. 9, pp. 412–414, 434, illus. November, 1946.

LARSON, LEE M. Two bears came to town. Nature Mag., Washington, vol. 39, no. 9, p. 480, illus. November, 1946. (Black bear.)

LATHAM, ROGER M. Know your whitetails. Field and Stream, New York, vol. 51, no. 7, pp. 52–53, 100–103, illus. November, 1946. (Deer.)

LAURENT, P. Etudes sur la biologie des cheiroptères dans le midi de la France (suite). Rapport de Mission (été 1942). Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol 15, no. 4, pp. 158–160. April–June, 1943.

LIDDELL, WAYNE C. Polygamous mating of foxes. Fur-Fish-Game, Columbus, vol. 87, no. 9, pp. 38–39. September, 1946.

LITTLEFIELD, E. W., W. J. SCHOONMAKER, and DAVID B. COOK. Field mouse damage to coniferous plantations. Jour. Forestry, Washington, vol. 44, no. 10, pp. 745–749, illus. October, 1946.

LLANOS, AUGUSTO C. Apreciaciones de campo con motivo de una concentracion de roedores en las provincias de Salta y Jujuy. Rev. Argentina Zoogeogr., Buenos Aires, vol. 4, nos. 1–2, pp. 51–57, pls. 3. 1945.

LORING, J. ALDEN. "Squeaking" animals. Nature Mag., Washington, vol. 39, no. 8, pp. 430–432, illus. October, 1946. (Red fox, marten, chipmunk, mink.)

LULL, RICHARD S. [Review of] Apes, giants and man; by Franz Weidenreich. Amer. Jour. Sci., New Haven, vol 244, no. 10, pp. 740–742. October, 1946.

MACARTHUR, ARTHUR. How to skin and prepare mink pelts. Amer. Fur Breeder, Duluth, vol. 19, no. 4, pp. 52, 54, 58. October, 1946.

———— How to skin and prepare mink pelts. Fur of Canada, Winnipeg, vol. 12, no. 2, pp. 49–50, illus. November, 1946.

MACDONALD, J. R. A new shrew from the Niobrara River Upper Miocene of Nebraska. Amer. Jour. Sci., New Haven, vol. 245, no. 2, pp. 123–126, figs. 2. February, 1947. (New: *Limnoecus niobrarensis*.)

MAHAN, FREDERICK. Deer for all. Wildlife in North Carolina, Raleigh, vol. 10, no. 3, p. 15. October, 1946.

MALKIN, GRACE F. Olive's strange pets. Canadian Nature, Toronto, vol. 8, no. 5, pp. 173–175, illus. November–December, 1946. (Striped skunk.)

MANN, WILLIAM M. A brief history of the Zoo. Scientific Monthly, Lancaster, vol. 63, no. 5, pp. 350–358, illus. November, 1946. (National Zoological Park, Washington, D. C.)

MATTHEWS, L. HARRISON. Notes on the genital anatomy and physiology of the gibbon (Hylobates). Proc. Zool. Soc. London, vol. 116, pt. 2, pp. 339–364, figs. 8. November, 1946.

MAXIMOV, A. A. Sur les migrations des isatis dans la partie nord europeene de l'URSS. Bull. Soc. Nat. Moscou, sect. biol., n.s., vol. 50, nos. 5–6, pp. 45–61, figs. 3. 1945. (In Russian, with French summary.)

MCBRIDE, JAMES K. Deer lick improvements. Ohio Conservation Bull., Columbus, vol. 10, no. 10, pp. 20–21, illus. October, 1946.

MCCRACKEN, HAROLD. The sacred white buffalo. Nat. Hist., New York, vol. 55, no. 7, pp. 304–309, 341, illus. September, 1946. (Albino American bison)

MCMAHON, C. A. Trapping the raccoon. Texas Game and Fish, Austin, vol. 4, no. 12, p. 30. November, 1946.

MELLEN, IDA M. The wolverine or glutton. San Diego Zoonooz, vol. 19, no. 12, p. 3, illus. December, 1946.

MEZGER, HERBERT P. Mutation mink comes of age. Nat. Fur News, Denver, vol. 18, no. 8, pp. 13, 40–41, 45. September, 1946.

MILLS, EDWIN. James W. Tyrrell, explorer. Beaver, Winnipeg, outfit 277, pp. 38–41, illus. September, 1946.

MONTAGNA, WILLIAM, and CHARLES R. NOBACK. The histology of the preputial gland of the rat. Anat. Record, Philadelphia, vol. 96, no. 1, pp. 41–54, figs. 6. September, 1946.

MOORE, JANET. Deer rendezvous. Nature Mag., Washington, vol. 39, no. 10, pp. 521, 550, illus. December, 1946. (Mule deer in Oregon.)

MORRISON, PETER R., and OLIVER P. PEARSON. The metabolism of a very small mammal. Science, Lancaster, vol. 104, no. 2700, pp. 287–289. September 27, 1946. (Shrew, *Sorex cinereus cinereus*.)

MORRISON-SCOTT, T. C. [Review of] Mammals of Nevada, by E. Raymond Hall. Nature, London, vol. 158, no. 4026, pp. 926–927. December 28, 1946.

NAGEL, W. O. The beaver—history maker—is coming back. Missouri Conservationist, Jefferson City, vol. 7, no. 9, pp. 6–7, 16, illus. September, 1946.

NAUMOV, S. P. Materials on the geographical and ecological distribution of marmots in the central Tian-Shan. Bull. Soc. Nat. Moscou, sect. biol., n.s., vol. 50, nos. 5–6, pp. 33–44. 1945. (In Russian, with English summary.)

NICOLL, PAUL A., and RICHARD L. WEBB. Blood circulation in the subcutaneous tissue of the living bat's wing. Ann. New York Acad. Sci., vol. 46, art. 8, pp. 297–711, fig. 1. September 16, 1946.

NOBBS, PERCY E. Moose rampant. Beaver, Winnipeg, outfit 277, pp. 42–44, illus. September, 1946.

OBOLENSKI, S. J. Notes on the biology of *Ellobius talpinus* Pall. in central Kazakhstan. Bull. Soc. Nat. Moscou, sect. biol., n.s., vol. 50, nos. 5–6, pp. 65–71. 1945. (In Russian, with English summary.)

OKADA, YAICHIRÔ, and TOSHIMASA HANAOKA. A study of Japanese Delphinidae (III). *Lagenorhynchus obliquidens* Gill. "Kama-iruka." Sci. Reports Tokyo Bunrika Daigaku, sect. B, vol. 4, no. 72, pp. 139–157, figs. 5, pls. 12–14. September 25, 1939.

———— A study of Japanese Delphinidae (IV). *Tursio borealis* (Peale). "Semi-iruka". Sci. Reports Tokyo Bunrika Daigaku, sect. B, vol. 4, no. 77, pp. 285–306, figs. 26. April 30, 1940.

OLIVE, JOHN R. Economic importance of moles. Ohio Conservation Bull., Columbus, vol. 10, no. 12, pp. 4–5, illus. December, 1946.

ORCUTT, EDALEE. Equus and his forbears. San Diego Zoonooz, vol. 19, no. 12, p. 4. December, 1946.

OTT, GEORGE L., and A. M. MCDERMID. Distemper at whelping time. American Fur Breeder, Duluth, vol. 19, no. 5, pp. 14, 18. November, 1946.

OWEN, R. D., H. P. DAVIS, and R. F. MORGAN. Quintuplet calves and erythrocyte mosaicism. Jour. Heredity, Washington, vol. 37, no. 10, pp. 290–297, figs. 1–4. October, 1946.

PAULUS, MARCEL. Études sur la faune quaternaire de la valée inférieure du Gard ou Gardon.—III. Les hyenes. Bull. Mus. Hist. Nat. Marseille, vol. 6, nos. 1–2, pp. 1–20, pls. 2. January–April, 1946.

PEARSON, OLIVER P. Scent glands of the short-tailed shrew. Anat. Record, Philadelphia, vol. 94, no. 4, pp. 615–630. April, 1946.

PEARSON, OLIVER P., and CHARLES F. BASSETT. Certain aspects of reproduction in a herd of silver foxes. Amer. Nat., Lancaster, vol. 80, pp. 45–67. January, 1946.

PHELPS, CHESTER F. Bicolor—a bushy lespedeza for quail and other wildlife. Virginia Wildlife, Richmond, vol. 7, no. 3, pp. 9–11, 22, illus. September, 1946. (Cottontail rabbits.)

PHELPS, DORIS. Endometrial vascular reactions and the mechanism of nidation. Amer. Jour. Anat., Philadelphia, vol. 79, no. 2, pp. 167–197, figs. 38. September, 1946. (Rhesus monkey.)

PIERCE, L. MERLE. Balance in fox breeding. Nat. Fur News, Denver, vol. 18, no. 8, pp. 20, 44. September, 1946.

RALL, YU. Dynamic density of rodents and methods of its study. Bull. Soc. Nat. Moscou, sect. biol., n.s., vol. 50, nos. 5–6, pp. 62–64. 1945. (In Russian, with English summary.)

REEDER, WM. G. Occurrence of mastiff bat remains in a pellet of the barn owl. Condor, Berkeley, vol. 48, no. 6, p. 282. November–December, 1946.

RICHTER, CURT P. Biological factors involved in poisoning rats with alphanaphthyl thiourea (ANTU). Proc. Soc. Exper. Biol. and Med., Utica, vol. 63, no. 2, pp. 364–372 fig. 1. November, 1946.

RODE, P. Sur les caractères différentiels des tetes osseuses de *Cercopithecus* et *Macaca*. Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 15, no. 4, pp. 151–154, figs. 3. April–June, 1943.

——— Catalogue des types de mammifères du Muséum National d'Histoire Naturelle. Ordre des rongeurs. Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 15, no. 5, pp. 275–282 (July–September, 1943); vol. 15, no. 6, pp. 382–385 (October–December, 1943); vol. 17, no. 1, pp. 24–31 (January, 1945); vol. 17, no. 2, pp. 95–102 (February, 1945); vol. 17, no. 3, pp. 201–208 (April, 1945); vol. 17, no. 4, pp. 292–300 (May, 1945). (Actual dates of publication are somewhat later than those given.)

RODIN, ROBERT J. Gray fox in Yosemite Valley. Yosemite Nature Notes, Yosemite, vol. 25, no. 10, p. 124. October, 1946.

RUSCH, H. P., V. R. POTTER, and J. A. MILLER. An improved feeder for mice. Proc. Soc. Exper. Biol. and Med., Utica, vol. 63, no. 2, pp. 431–432, fig. 1. November, 1946.

RUSCONI, CARLOS. Restos de huesos fosiles en una cueva de Malalhue (Mendoza). Anales Soc. Cien. Argentina, Buenos Aires, vol. 141, no. 6, pp. 241–249, figs. 3. June, 1946.

RUTHERFORD, R. M. Federal aid in wildlife restoration. General information. U. S. Dept. Interior, Fish and Wildlife Serv., Regulatory Announcement, no. 18, pp. 12. December, 1946.

RUUD, JOHAN T. Further studies on the structure of the baleen plates and their application to age determination. Hvalrådets Skrifter, Scientific Results of Marine Biological Research, Oslo, no. 29, pp. 69, figs. 28. 1945.

SALA DE CASTELLARNAU, IGNACIO. Un extraño cetaceo en las costas de Valencia *Ziphius cavirostris* Cuvier. Anales Asoc. Española Progreso Cien., Rev. Trimestral, Madrid, año 10, no. 3, pp. 576–583, illus. 1945.

SANBORN, COLIN CAMPBELL. Caracteres externos de los murcielagos de la sub-familia Glossophaginae. Bol. Mus. Hist. Nat. "Javier Prado", Lima, año 9, nos. 34–35, pp. 331–339, illus. 1945. (Spanish translation of article originally published in Zool. Ser. Field Mus. Nat. Hist., vol. 24, no. 25, pp. 271–277, January 6, 1943.)

SANDERS, JAMES M. Successful interchange of ovaries between albino rats and mice. Science, Lancaster, vol. 104, no. 2698, p. 257. September 13, 1946.

SCHERMERHORN, JACQUELINE. Denizens of the underbrush. San Diego Zoonooz, vol. 19, no. 11, p. 3, illus. November, 1946. (Hedgehog.)

SCHULTZ, C. BERTRAND, and CHARLES H. FALKENBACH. Merychyinae, a subfamily of oreodonts. Bull. Amer. Mus. Nat. Hist., New York, vol. 88, art. 4, pp. 157–286, figs. 17, tables 6, charts 4. March 25, 1947. (New: *Merychyus arenarum idahoensis*, *M. crabilli*, *M. elegans bluei*, *M.* (*Metoreodon*) *relictus taylori*, *M.* (*Metoreodon*) *relictus fletcheri*, *Paramerychyus* for *Merychyus harrisonensis* Peterson, *Oreodontoides* (*Paroreodon*) *stocki*.)

SCHULTZ, C. BERTRAND, and W. D. FRANKFORTER. The geologic history of the bison in the Great Plains. (A preliminary report.) Bull. Univ. Nebraska State Mus., Lincoln, vol. 3, no. 1, pp. 1–10, fig. 1. December, 1946.

SCOTT, THOMAS G. What mammal is that? Iowa Conservationist, Des Moines, vol. 5, no. 8, pp. 57, 60, 64, illus. August 15, 1946. (Opossum, mole, shrew.)

SEAGEARS, CLAYTON B. The fox in New York. New York State Conservation Dept., Albany, Educational Bull., pp. 85, (not numbered), figs. 37. 1944.

SEROVA, OLGA. Sable preserve on the shore of Lake Baikal. Amer. Fur Breeder, Duluth, vol. 19, no. 3, p. 60. September, 1946.

SHACKELFORD, RICHARD M. Breeding mutation mink. Amer. Fur Breeder, Duluth, vol. 19, no. 2, pp. 8–14; no. 3, pp. 10–26; no. 5, pp. 30–32, illus. August, September, November, 1946.

SHARRITT, GRACE V. Home-coming of the elk. Audubon Mag., New York, vol. 48, no. 6, pp. 348–354, illus. November–December, 1946.

SHORTEN, MONICA R. The distribution of the grey squirrel and the British red squirrel in Lincolnshire. Trans. Lincolnshire Nat. Union, pp. 108–114. November, 1946.

SILVA, JOÃO AUGUSTO. Animais selvagens. Cintribução para o estudo da fauna cinegética de Moçambique. O hipopótamo. Moçambique, Documentario Trimestral, Lourenço Marques, no. 48, pp. 29–48, pls. 5. December, 1946.

SMALL, JOE AUSTELL. Dionne of the deer family. Sports Afield, Minneapolis, vol. 116, no. 4, pp. 32, 75, illus. October, 1946.

SMITH, LLOYD M. Mountain lion visits Yosemite Valley. Yosemite Nature Notes, Yosemite, vol. 25, no. 10, p. 123, illus. October, 1946.

SMITH, MALCOLM A. Stanley Smyth Flower 1871–1946. Copeia, Ann Arbor, 1946, no. 4, pp. 185–178, photo. December 30, 1946. (Obituary.)

STAGER, KENNETH E. The reindeer. Los Angeles County Mus. Quarterly, Los Angeles, vol. 5, no. 4, pp. 12–14, illus. Winter, 1946.

STEELE, ZULMA. How the camel came to America. Fauna, Philadelphia, vol. 8, no. 3, pp. 78–79, illus. September, 1946. (Introduced in 1856.)

STEEN, M. O. The deer and the deer hunt. Missouri Conservationist, Jefferson City, vol. 7, no. 10, pp. 1–3, 16, illus. October. 1946.

STOTT, KEN, JR. Primate babies. San Diego Zoonooz, vol. 19, no. 11, pp. 6–7, illus. November, 1946.

——— South African swan songs. San Diego Zoonooz, vol. 19, no. 12, pp. 5–6, illus. December, 1946. (Game animals.)

TATE, G. H. H. Results of the Archbold Expeditions. No. 56. On the anatomy and classification of the Dasyuridae (Marsupialia). Bull. Amer. Mus. Nat. Hist., New York, vol. 88, art. 3, pp. 97–156, fig. 1. February 20, 1947. (New: *Antechinus mayeri misim*, *A. wilhelmina*, *Parantechinus*, *Pseudantechinus*, *Myoictis melas wavicus*.)

TERRES, JOHN K. Let's bring the wildlife back to the woods. Audubon Mag., New York, vol. 48, no. 5, pp. 294–300, illus. September-October, 1946.

THOMASON, HUGH. The hippo charmer. Fauna, Philadelphia, vol. 8, no. 4, pp. 108–111, illus. December, 1946.

THONE, FRANK. Bedtime for bears. Science News Letter, Washingtou, vol. 50, no. 11, p. 174. September 14, 1946.

——— Down from the trees. Science News Letter, Washington, vol. 50, no. 16, p. 254. October 19, 1946. (Man's ancestors.)

THORNBURG, ROSS and FLORENCE. Tuft-eared squirrels. Nature Mag., Washington, vol. 39, no. 10, pp. 523–524, illus. December, 1946. (Abert and kaibab squirrels.)

THRAPP, DAN L. Vicuña! Nature Mag., Washington, vol. 39, no. 9, pp. 469–472, 498, illus. November, 1946.

TITUS, HAROLD. What ails the Appalachians? Field and Stream, New York, vol. 51, no. 7, pp. 62–63. November, 1946. (Deer.)

TOMILIN, A. G. Thermoregulation and the geographical races of cetaceans. Comptes Rendus (Doklady) Acad. Sci. URSS, Moscow, vol. 54, no. 5, pp. 465, 468. November 20, 1946.

TRESTER, LAURA MARKHAM. Saving the bighorns. Frontiers, Lancaster, vol. 11, no. 1, pp. 3–4, 26–27, illus. October, 1946.

ULMER, FREDERICK A., JR. "Man of the woods." Fauna, Philadelphia, vol. 8, no. 4, pp. 98–103, illus. December, 1946. (Orang-utan.)

URBAIN, ACH., J. NOUVEL, and P. BULLIER. Rapport sur la mortalité et la natalité enregistrées au Parc Zoologique du Bois de Vincennes en 1945. Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 18, no. 2, pp. 146–157. February, 1946.

VALLOIS, HENRI V. Les nouveaux pithécanthropes et le problème de l'origine de l'homme. La Nature, Paris, no. 3125, pp. 367–370, figs. 3. December 1, 1946.

VAN DEN BRINK, F. H. Lijst van Nederlandsche Vertebrata. Martinus Nijhoff, The Hague, pp. 56. 1943. (Mammals, pp. 48–56.)

VARELA, GERARDO, CARLOS ORTIZ MARIOTTE, and ROBERTO SILVA. Complement fixation in rat's blood sera. Science, Lancaster, vol. 104, no. 2700, p. 303. September 27, 1946.

VINSON, CARLOS. Wild "Rooshians" of Tennessee. Nature Mag., Washington, vol. 39, no. 8, pp. 405–406, illus. October, 1946. (Wild boars.)

W——, R. S. The human side of squirrels. Flower and Feather, Chattanooga, vol. 2, no. 4, pp. 18–20. October, 1946.

WALTON, ARTHUR, and W. URUSKI. The effects of low atmospheric pressure on the fertility of male rabbits. Jour. Exper. Biol., London, vol. 23, no. 1, pp. 71–76. October, 1946.

WASHBURN, A. L. The Arctic Institute. Beaver, Winnipeg, outfit 277, pp. 45–48, illus. September, 1946. (Notes on mammals.)

WEBB, C. E. A beaver dam in Ohio. Ohio Conservation Bull., Columbus, vol. 10, no. 12, p. 25, illus. December, 1946.

WEBB, J. E. Spiracle structure as a guide to the phylogenetic relationships of the Anoplura (biting and sucking lice), with notes on the affinities of the mammalian hosts. Proc. Zool. Soc. London, vol. 116, pt. 1, pp. 49–119, figs. 216. May, 1946.

WEIDENREICH, FRANZ. Generic, specific, and subspecific characters in human evolution Jour. Physical Anthropol., Philadelphia, n.s., vol. 4, pp. 413–430. December, 1946.

WESTCOTT, ROUEN J. "Brains." The story of some fighting men, a "mouse," and an idea called Freedom. Nat. Hist., New York, vol. 55, no. 7, pp. 331, 341–342, illus. September, 1946. (Kangaroo rat in Arizona.)

WHEELER, J. F. G. Observations on whales in the South Atlantic Ocean in 1943. Proc. Zool. Soc. London, vol. 116, pt. 2, pp. 221–224, fig. 1. November, 1946.

WOLFE, J. M. Effects of progesterone on the cells of the anterior hypophysis of the rat. Amer. Jour. Anat., Philadelphia, vol. 79, no. 2, pp. 199–239, pl. 1. September, 1946.

WOODS, GORDON T. The wolverine. Nature Mag., Washington, vol. 39, no.8, pp. 426–428 444, illus. October, 1946.

WOOLLEY, DONALD L.: Virginia animals everyone should know. The white-tailed deer. Virginia Wildlife, Richmond, vol. 7, no. 5, pp. 6–7, 16, illus. November, 1946.

YEPES, José Comentarios sobre cien localidades nuevas para mamiferos sudamericanos. Rev. Argentina Zoogeogr., Buenos Aires, vol. 4, nos. 1–2, pp. 59–71. 1945.

——— El piche de oreja corta (*Zaedyus pichiy*) integra con su distribucion el total del distrito patagonico. Rev. Argentina Zoogeogr., Buenos Aires, vol. 4, nos. 1–2, p. 83. 1945.

YOUNG, J. Martin, Jr. Life saving arrows. Winter starvation threatened the wandering deer of Colorado until ingenious wildlife wardens found a way to "brand" them from a distance. Nat. Hist., New York, vol. 55, no. 9, pp. 424–425, illus. November, 1946.

YOUNG, STANLEY P. On the scream of the puma. Amer. Forests, Washington, vol. 52, no. 9, pp. 408–409, 442, illus. September, 1946.

COMMENT AND NEWS

INTERNATIONAL CONGRESS OF ZOOLOGY TO MEET IN PARIS

The 13th International Congress of Zoology will meet in Paris July 21 to July 27, 1948. M. Caullery, president of the permanent committee of the Congress of Zoology, will preside.

There will be ten sections dealing with zoological subjects, as follows: (1) General Zoology, (2) Evolution and Genetics, (3) Cytology and Protozoology, (4) Comparative and Experimental Embryology, (5) Vertebrate Zoology (two sections, A. Comparative Anatomy, and B. Systematics and Ecology), (6) Invertebrate Zoology Exclusive of Insects (including systematics, anatomy, embryology and physiology), (7) Entomology, (8) Applied Zoology and Parasitology, (9) Zoogeography and Paleontology, (10) Nomenclature.

Correspondence concerning the Congress should be addressed to the general secretary, M. Fischer-Piette, Professeur au Museum, 55, Rue de Buffon, Paris, France. Detailed programs of the Congress will be available at a later date.

COMMITTEE FOR RELIEF OF EUROPEAN MAMMALOGISTS

The American Society of Mammalogists has appointed the "Emergency Committee for the Relief of European Mammalogists." Many scientists that were not bombed out were driven out of their homes by the Nazis and are now starving and homeless along with hundreds of other Europeans.

Since members of the American Society of Mammalogists are particularly interested in maintaining mammalogy as an international science, it seems fitting that we should extend help to our colleagues. The same plan has been carried out by the American Ornithological Union in the case of ornithologists, and the responses they have received from cold and hungry Europeans have been pathetically grateful.

We appeal, therefore, to all members of the American Society of Mammalogists to donate what they can to feed and clothe these unfortunate people. A letter has been sent out to all members, explaining the plan in more detail.

TWENTY-SEVENTH ANNUAL MEETING

TWENTY-SEVENTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The twenty-seventh annual meeting of the American Society of Mammalogists was held at the Conservation Training School, Michigan Department of Conservation, Higgins Lake, Michigan, August 24–27, 1947. Approximately 120 members and guests attended.

PROGRAM

SUNDAY, AUGUST 24

2:00 p.m.

Registration and Information, Administration Building

7:30 p.m.

Meeting of the Board of Directors—Classroom Building

MONDAY, AUGUST 25

8:00 a.m.

Registration and Information

8:45 a.m.

Address of Welcome—*H. D. Ruhl*, Chief, Game Division, Michigan Department of Conservation

1. The origin and distribution of Recent North American mammals. *Kenneth Gordon*, Oregon State College.
2. Geographic relationships of the mammalian fauna of the Sweetwater Mountains, California. *Seth B. Benson*, University of California. Slides.
3. A report on the status of mammals of the United States National Park system. *Victor H. Cahalane*, U. S. National Park Service.
4. Applied ecology of predation on livestock ranges. *Clifford C. Presnall*, U. S. Fish and Wildlife Service.
5. Preliminary report or the ecology of moose in Ontario. *Randolph L. Peterson*, Royal Ontario Museum of Zoology. Slides.
6. An earlier American mammal society. *Hartley H. T. Jackson*, U. S. Fish and Wildlife Service.
7. The natural history of Oregon. *Kenneth Gordon*, Oregon State College. Kodachrome motion pictures.

1:30 p.m.

Symposium on Populations, Home Ranges, and Territories in Mammals

8. Techniques for capture and marking of mammals. *Richard H. Manville*, Michigan State College.
9. Selection of areas for study. *William J. Hamilton, Jr.*, Cornell University.
10. Spacing of traps. *Carl O. Mohr*, U. S. Public Health Service. (Read by title only.)
11. Calculation of home range size. *Don W. Hayne*, Michigan State College.
12. Calculation of populations. *Lucille F. Stickel*, U. S. Fish and Wildlife Service. (Read by title only.)
13. Fluctuations in populations. *C. H. D. Clarke*, Department of Lands and Forests, Ontario.
14. Territoriality. *William H. Burt*, University of Michigan.
15. Purposes of population studies. *Durward L. Allen*, U. S. Fish and Wildlife Service.

TUESDAY, AUGUST 26

8:30 a.m.

16. An analysis of source of *Microtus* captured on a one-acre plot. *Don W. Hayne*, Michigan State College. Slides.
17. Shrew-mouse predation during a period of low mouse abundance. *W. Robert Eadie*, Cornell University.
18. Live-trapping mink in the University of Wisconsin Arboretum. *Robert McCabe*, University of Wisconsin. Slides.
19. Distribution of rats in the United States. *Tracy I. Storer*, University of California.

10:00 a.m.

Annual Business Meeting of the Society; election of officers

1:00 p.m.

20. Studies on the home range of the brown rat. *David E. Davis*, Johns Hopkins University. Slides.
21. The hibernation of bats in southeastern Ontario and adjacent parts of Quebec. *Harold B. Hitchcock*, Middlebury College. Slides.
22. Growth and behavior of the pallid bat (*Antrozous pallidus*) in captivity. *Robert T. Orr*, California Academy of Sciences. Slides.
23. The dusky-footed wood rat. *Jean M. Linsdale and Lloyd P. Tevis, Jr.*, Hastings Reservation, University of California.
24. Molt pattern as an age criterion in muskrats. *James Beer*, University of Wisconsin. Slides.

25. Habits and abundance of the gray whale. *Carl L. Hubbs*, Scripps Institution, University of California. Slides.
26. A check on the gestation period of the Canadian porcupine (*Erethizon d. dorsatum*). *Albert R. Shadle*, University of Buffalo.
27. Natural history notes on the Florida flying squirrel. *Joseph C. Moore*, University of Florida.
28. Systematic review of the land mammals of Washington. *Ernest S. Booth*, Walla Walla College.

6:00 p.m.

Annual Banquet—on the shore of Higgins Lake

Mr. Ben East with Kodachrome motion pictures

"Alaskan Wildlife"

WEDNESDAY, AUGUST 27

8:00 a.m.

Meeting of the Board of Directors

8:30 a.m.

29. Geographic variation in the piñon mouse, *Peromyscus truei*. *Donald F. Hoffmeister*, University of Illinois. Slides.
30. The Pennsylvania Mammal Survey. *J. Kenneth Doutt*, Carnegie Museum.

9:30 a.m.

Final Business Meeting

At the meeting of the Board of Directors on August 24, 1947, H. E. Anthony was re-elected to succeed himself for a three-year term as trustee. William B. Davis' resignation as chairman of the editorial board was accepted and he was accorded a vote of thanks for his work as editor. William H. Burt was appointed editor and chairman of the editorial board. The acceptance of the invitation extended the Society by the Royal Ontario Museum of Zoology to hold the 1948 annual meeting in Toronto was reaffirmed and the suggestion made that the Society would prefer the time of Easter vacation for the meeting. It was decided, by vote, that for the purposes of the Society, the duration of World War II has terminated and those members carried on inactive status for the duration, be so informed. If they do not affiliate by the end of the fiscal year, January 31, 1948 they will be dropped as members.

At the annual business meeting on August 26, 1947, the following officers were elected: Remington Kellogg, President; Lee R. Dice and Tracy I. Storer, Vice-presidents; Robert T. Orr, Recording Secretary; Donald F. Hoffmeister, Corresponding Secretary; Viola S. Schantz, Treasurer. Five directors were elected for the period 1947–1949, as follows: Seth B. Benson, Victor H. Chalane, William B. Davis, William J. Hamilton, Jr., and Emmet T. Hooper. Olaus J. Murie was elected to fill the vacancy on the board of directors for the period 1946–1948 created by the appointment of William H. Burt to the editorship. Dr. Rudolph M. Anderson and Dr. Angel Cabrera were elected to honorary membership.

It is with deep regret that the Society learned of the death of eleven members, five of whom were charter (*) members: Clinton G. Abbott, *Thomas Barbour, *Frank L. Burns, William T. Davis, Brooke Dolan, 2nd, *E. A. Goldman, Theodore R. Hubback, Daniel N. Kashkarov, *T. S. Roberts, W. W. Scalon, *Ernest T. Seton.

The corresponding Secretary presented a summary of membership and subscription as follows:

MEMBERSHIPS	1945		1946	
Change since preceding annual report				
Nominees		82		120
Resignations	7		21	
Deaths reported	12		11	
Members dropped (delinquent)	27		13	
Total		46		45
Net Change		+36		+75
Status as of December 31				
Honorary members (1 also Life, 1945)	3		2	
Life members	49		51	
Members inactive for duration	65		54	
Annual members (excluding above inactive members)	802		886	
Total membership		919		993
Corrected total (one member both Life and Honorary, 1945)		918		993

SUBSCRIPTIONS				
Change since preceding report				
New subscriptions	23		73	
Subscriptions cancelled	11		19	
Net Change		+12		+54
Status as of December 31				
Total paid subscriptions		237		291

MAILING LIST				
Total membership	918		993	
Members not receiving Journal	116		111	
Total members receiving Journal		802		882
Total paid subscriptions		237		291
Total mailing list		1039		1173
Net change from preceding year		+70		+134

Reports of the following standing committees were read and accepted: Life Histories and Ecology, Anatomy and Phylogeny, Marine Mammals, Economic Mammalogy, Conservation of Land Mammals, Membership, and Editorial Committee. Reports of the Index Committee and various representatives to other societies were presented.

Upon recommendation at the business meeting, the report of the Committee on Life Histories and Ecology and the Committee on Economic Mammalogy are printed below:

Life History and Ecology: We are all aware of the physical changes that have taken place in our country as a consequence of our economic developments. It was inevitable that there should be conflict between man's economic interests and those of wildlife. It was inevitable that wildlife should suffer.

We have been trying to adjust those differences and to preserve our wildlife. Inevitably there have been clashes of opinions and bitter controversies. Two of the chief obstacles to agreement have been difference of viewpoint and lack of scientific information.

We have done some outstanding work on relations between predators and certain wild prey species. Ecologists have made some progress in study of life histories of certain rodents—pocket gophers and jackrabbits, for example—to determine their effects on soil and vegetation. But we have only begun to study relations between predators and domestic animals from a truly ecological standpoint. Some studies that have come to the attention of members of this committee indicate that there are important relationships between coyote predation on cattle and range conditions; that it is important to learn more about bears and cattle and sheep. We would point out that the State of Arizona has recently placed the black bear on the predatory animal list.

It would be generally agreed that our wildlife problem is largely one of finding means for sharing the earth's environment with wild species, without extermination of the latter. At no time in the history of conservation has there been greater need for the ecological approach to the problem of predators and rodents versus livestock and agriculture. We believe that the Research Division of the Fish and Wildlife Service has made a beginning in that direction, but the problem is big and widespread, and is a challenge to scientists of the American Society of Mammalogists.

It is becoming apparent today that our primitive wildlife environment is rapidly disappearing. This trend affects many classes of people. It affects the hunter and fisherman, those who seek outdoor recreation in other ways, especially those who desire wild country for their enjoyment. It also definitely affects naturalists, including mammalogists who are concerned in any way with life histories and ecology.

Ecologists have organized the Ecologists Union, whose primary purpose is the preservation of natural areas. Note also the international organizations, through whose efforts the setting aside of natural areas in Africa and other countries was encouraged. It was in accord with destiny, in view of modern trends, that the Wilderness Society was organized in 1935, and that such technical groups as the American Society of Mammalogists and the Wildlife Society, at their annual meetings, endorsed the Wilderness movement.

There is value of the highest importance in preserving unspoiled areas throughout the world for the study of mammalian life histories and ecology, and no life history today can be properly studied without emphasis on ecology. Our interest here coincides so well with the interests of other groups—for example, the range student, the Ecologists Union, The Wilderness Society, the Wildlife Society, the Izaak Walton League of America, our ornithological societies, the National Audubon Society, and many others that could be enumerated—that our particular cause, to provide continued opportunity for mammalian ecological study, could best be served by close cooperation with others who seek the same end for different reasons.

There is the wolf situation in Mt. McKinley National Park, in Alaska. As a people we have professed to agree that the wolf should not be entirely exterminated but should eventually find a refuge, vaguely "in the wildest part of the country." Yet when the slightest inclination to tolerate the species in a national park farthest removed from agricultural activities was expressed, protests arose, and one sportsmen's group has caused to be introduced in Congress a bill to make Mt. McKinley National Park a game refuge, and to make killing of carnivores mandatory. The bill is still pending and may be enacted.

There is a demand to control coyotes in Yellowstone National Park, because it is believed that individuals wander out of the Park in numbers sufficient to damage domestic sheep and game interests outside the boundaries. Investigation of the matter is in the capable hands of Mr. Kalmbach's research laboratory of the Fish and Wildlife Service at Denver.

There is a question of survival of such mammals as the marten, wolverine and fisher. The marten is still common in some protected areas, notably in national parks, or other areas adjacent to national parks. The fisher is rare. The wolverine eventually will have no chance of survival in sanctuaries of the wilderness type. For the fisher and wolverine the sanctuary must be large enough to contain them, so that in their wide wanderings they do not go outside of the boundaries too frequently. It is notorious that such mammals as the mountain lion, with wide ranging habits, can be "drained" out of a sanctuary by hunting at the borders.

The wolverine was "drained" out of the Yellowstone Park in that manner, possibly because the best range existed near the border. The fisher may disappear from other areas in a similar way, if the areas are too small. Undoubtedly the reason marten can still be profitably trapped on the national forests of northwestern Wyoming is the fact that this species does not travel as widely as some of the others and that Yellowstone and Teton parks have served as biological reservoirs for such mammals.

For these reasons we deplore current efforts to cut down the boundaries of national parks and wilderness areas, such as the move to eliminate thousands of acres of the rain forest of Olympic National Park of Washington, particularly on the Bogachiel River, the most primitive portion of the park. The wolf was eliminated from that area before the present park was created. With progressive reduction in area for lumbering purposes the cougar will be endangered.

Consider the wide-ranging caribou of Alaska and Canada. Studies by the Fish and Wildlife Service indicate that the crucial lichen forage can not withstand close use, and that caribou require extensive populations and big range in order to survive. And there are other pertinent ecological factors.

With the booming and boosting for the far north, what provisions will be made for the caribou? Will they disappear in the face of hastily conceived colonization experiments and possible efforts to raise reindeer?

We are faced with danger to our marine mammals, among others the harbor seal and sea-lion. In such controversies we are again in need of factual data and scientific advice based on ecological consideration. And we are here caught in the whirl of conflicting interests—such as the fishermen who fear the loss of some salmon by seals or sea-lions and the federal power and irrigation interests who do not hesitate to sacrifice salmon streams of an important section of our continent.

It is obvious that our only chance to preserve many of our larger mammal species is to preserve wild areas of sufficient size. Such areas need not be devoted only to preservation of certain animal species, but may have a much broader purpose. After all, conservation at its best does not concern itself today with certain selected species, but with a combined fauna and flora. An animal is valuable to an ecologist primarily when available in its suitable environment. Therefore, the "wilderness" concept that has been developing in the last few years becomes a godsend to those of us with the particular interests of the naturalist and ecologist. The wilderness concept combines a variety of features that are of concern to so many different groups, based on the same requirement of preserving the original conditions, that we have a much greater chance of success in keeping such areas than if we were striving alone.

The point should be made that the ecologist of today faces a new task. He can no longer expect to pursue his routine studies untouched by the world. He is confronted with a challenge. He is faced with the need to help shape a culture and a social pattern. He must take part in forming land use policy on a prodigious scale. He can be of tremendous help to the conservation movement in its broadest and highest sense. It is this challenge and this opportunity that the Committee on Life Histories and Ecology can best present to the members of the American Society of Mammalogists.—ALFRED M. BAILEY, W. FRANK BLAIR, EDWIN V. KOMAREK, ADOLPH MURIE, DONALD SPENCER, AND OLAUS J. MURIE, *Chairman*.

Economic Mammalogy: Dr. R. M. Anderson reports: Little has really been done on economic mammalogy in Canada, and what has been done has been isolated and scattered. The nineP rovinces are only loosely confederated in some respects, and the control of mammals, except in Yukon Territory and the Northwest Territories, is left to the Provinces. The Department of Agriculture confines its efforts to domestic stock. While the National Museum has made studies of Canadian wildlife in general, the staff is small and field work irregular and sporadic, and special work on wild life is carried on for other branches by special request. Several men are conducting good work in economic mammalogy in Canada now: Ian McTaggart Cowan, University of British Columbia, for three seasons has been working in the Rocky Mountains National Parks in western Alberta; J. Dewey Soper in Manitoba;

C. H. D. Clarke, after having worked for the National Museum and the National Park Bureau, is doing intensive mammal work for the Ontario Lands and Forests Branch.

Dr. S. C. Kendeigh reports: It seems to me that the accurate measurement of population sizes is fundamental in all problems in the economic control of mammals. I wonder if it is not about time that some one be encouraged to analyze methods of measuring populations of various animal groups and give at least preliminary evaluation of the various methods. There is of course considerable work being done in this field and perhaps some one should round up the evidence now available to see just how far we have progressed. This should crystallize thinking and attention to the problem and encourage more study and development of methods.

Another problem deserving immediate attention perhaps is the naturalization of the coypu. I am told that these animals have been escaping and are becoming established in various parts of Kansas, Washington, Oregon, British Columbia, Montana, and New Mexico. Some one should be keeping track of what happens to these scattered colonies as to their success in maintaining themselves, their rate of spread and the extent of their competition with native species.

Dr. Tracy I. Storer has directed (with the assistance of Marjory P. Mann) the compiling of a "Bibliography of Rodent Control". This mimeographed document was prepared for the Committee on Medical Research of the O.S.R.D. under the sponsorship of the Rodent Control Subcommittee, Insect Control Committee, of the National Research Council. The compilation embraces 3401 non-Russian titles and 465 from Russian sources. The former group is segregated under nine topical groupings which permit reference with reasonable facility. No means least in importance is the section including the Russian titles, a mass of literature little known in this country. A limited edition of approximately 550 copies was issued and these have largely been distributed to libraries, institutions and agencies more or less directly interested in the subject matter compiled.

Mr. E. R. Kalmbach reports: My own long-standing conviction is that more accurate appraisals of mammalian economics are needed. Much of what has been written and is being used as a basis for operational work is of doubtful statistical validity. A case in point is the abandon with which certain "appraisals" of damage of commensal rats have been thrown about. Fully a quarter century ago the figure of a $200,000,000 loss in the United States was given wide circulation. Recently that same figure, as well as $300,000,000 and even $500,000,000 have been used. When approached on the subject, a member of this committee residing in California confided that he had no idea of what that estimate should be for his own state. I am certain there are no adequate data even for the city of Denver and question my ability to compute such losses even for the residential section in which I live.

I have been concerned with the approach to certain range problems so frequently thought of merely in terms of reductional rodent control. When, however, we come to problems in rodent control on range lands, much of which have been subjected to severe pressure from livestock and, no doubt, from rodents as well, other considerations enter. I will not go into the story of what started all of this and who is to blame for the first transgression. The fact is we are confronted with a problem of range rehabilitation and range management in the correction of which rodent control may be called for, at least to get things moving in the right direction.

I have yet to be convinced, however, that rodents are the sole or even primary cause of most cases of range degeneration. The evidence is too emphatic in the direction of excessive domestic use plus the devastating and superimposed effects of drougth and erosion. Frequently though, rodents may aggravate or accelerate range destruction, or prevent its rehabilitation. They are, nevertheless, only one contributing factor and in many cases may actually be the visible after-effect rather than the cause of range deterioration.

All of the foregoing leads me to a conviction, strengthened immeasurably by contact with such matters in recent years, that rodent control on range lands should be looked upon only as one among a number of remedial procedures that may have to be undertaken. It, alone,

in the face of continued abuse of the range, may serve, at best, as a momentary palliative. Under some conditions assumed benefits from rodent control might even lead to still greater use of the range by livestock and thus hasten a degeneration already under way. In the face of such a possibility field rodent control might better not be instituted.

There should in my opinion be a much closer integration of field rodent control with the other well-known principles of sound range management. In fact, the ideal would be a relationship that would sanction rodent control on over-used ranges only if other practices, aimed to accomplish the same objective, also were employed.

At the present time there are no regulatory measures to enforce such a procedure, yet there are powers of persuasion, education and demonstration that can bring this about even more effectively than any legal statute. It remains for those agencies engaged in common effort to rehabilitate range lands to join forces. It strikes me that here is a field of endeavor in which our Society could well use its influence toward urging a fuller coordination of all the measures needed for range and soil conservation.—R. M. ANDERSON, S. C. KENDEIGH, D. A. SPENCER, C. T. VORHIES, T. I. STORER, AND E. R. KALMBACH, *Chairman*.

At the final business meeting, held on August 27, the following resolutions were adopted:

Resolved that the American Society of Mammalogists commends the local committee for its originality in choice of setting for the 1947 annual meeting and appreciates the careful planning which provided such splendid arrangements for the sessions. Be it also resolved that the thanks of the Society be extended to the Michigan State Department of Conservation for use of the Higgins Lake Conservation Training School.

Whereas the natural reestablishment of wolves in Yellowstone National Park would alleviate some problems resulting from lack of balance now present in the native fauna and enhance the value of the Park;

Whereas the cessation of predator destruction by the U. S. Fish and Wildlife Service in a mountainous corridor connecting the Park with wolf-inhabited mountains to the north would probably permit wolves to drift naturally into the Park;

Therefore, be it resolved, that the American Society of Mammalogists requests that the U. S. Fish and Wildlife Service study the feasibility of such a corridor and invites the Director of the Service to report on the results of this study at the 1948 meeting of this Society.

Whereas the American Society of Mammalogists at its 1946 annual meeting acting on plans announced for construction of animal enclosures within the Jackson Hole National Monument by private interests opposed such installations and urged its members to exert their influence for maintenance of the natural areas within the national parks and monuments and for the exclusion of all accommodations and arrangements that would confine wildlife or provide visitors any unnatural presentation of the fauna in such areas;

Whereas the private interests referred to have now established the Jackson Hole Wildlife Park and have substituted for part of the original objective a research project on free-living fauna and flora without yet placing any wildlife within enclosures or on display;

Therefore, be it resolved, that the American Society of Mammalogists commends the officials of Jackson Hole Wildlife Park for their emphasis on research and the Society urges them to continue this plan toward full development of a research station and to abandon plans for any unnatural presentation of wildlife.

Whereas Mount McKinley National Park is an outstanding sanctuary for many forms of Alaska wildlife and offers unique opportunities for observation and scientific study of rare carnivores in relation to the big game and other prey animals;

Whereas the preservation of the complete fauna there represented is of national importance;

Whereas the National Park Service administers the Park as a sanctuary in accordance with basic federal law, gives protection to all native forms of wildlife, and carries out needed protective measures according to the findings of qualified naturalists;

Therefore, be it resolved, that the American Society of Mammalogists opposes enactment by the Congress of any law that would change the character of the Park as a sanctuary for all kinds of wildlife, or that would direct the National Park Service to destroy wolves or other carnivores without discrimination, or that would alter present policies whereby protection of bighorn sheep and other game species is based on scientific investigations.

Whereas proposals have been made to readjust the boundaries of Olympic National Park to permit lumbering in the extensive western rain forests of the Park;

Whereas these areas are of special value in maintaining the local native fauna and flora which are of scientific value and interest to mammalogists and other naturalists;

Therefore, be it resolved, that the American Society of Mammalogists joins with other conservation organizations in opposing all measures that would decrease the area of the Park or lessen its value as a sanctuary.

Be it further resolved that the Secretary of the Society is directed to send copies of this resolution to the chairmen of the Public Lands Committees of the United States Congress.

Recommendation: individual members of the Society are urged to ask their representatives to defeat all such measures.

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